The Welding Engineer

METAL SHOW ISSUE, OCTOBER, 1944

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It's *Featherlight!*

Jackson's A-4W

—Definitely Cuts Fatigue

Ideal for Women

The Jackson ***Featherlight*** A-4W is an unusual electrode holder. It is the ***lightest*** fully insulated, tong-type holder ever developed. Its jaws are opened ***easily***—increased leverage and smooth pivot action eliminates hand fatigue.

You'll like its sturdy simplicity, its firm grip on the electrode, its extra long life, the ***ease*** and ***speed*** with which it is manipulated. With the A-4W—as with *all* Jackson Holders—you can use rods right down to the end of the flux.

Study the illustration. ***Buy*** this holder, ***use*** it, and you'll understand why it's an outstanding example of perfection.

CONSIDER THESE ADVANTAGES

- **Featherlight:** 50% weight reduction.
- **Tongs** are of tough **light weight** alloy.
- **Copper Jaws,** quickly and easily **replaceable.**
- **Insulators:** New Crown Type with Metal-Clad jaw insulators . . . last many times longer.
- **Maintenance:** Replaceable Copper Jaws and Metal-Clad jaw insulators cut maintenance at least 50%.
- **Ventilation:** Free flowing . . . no holder works cooler.
- **New Tong Pivot-Hinge:** Easily knocked down and assembled.
- **Cable Connection:** Mechanical.
- **Capacity:** 1/4" electrodes.

Contact your nearest Jackson dealer or write to us.

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In Canada: Hollup Corporation Limited, Toronto • Paragon Supplies Limited, Vancouver

A DREAM COME TRUE

The Holder always hoped for...

Jackson's *Featherlight* A-4

You have dreamed of the ideal holder—the holder you hoped would some day be created and offered for sale.

Today, you can have it!

We have created this holder and carefully field tested it to meet the exacting specifications of your ideal. We offer it to you as the finest holder ever developed. Welders who have used Featherlight A-4 and A-5 tell us they are "dreams come true".

Study the illustration, consider the advantages and you'll understand why the purchase of these holders is a profitable investment.

- **Featherlight:** *40% weight reduction.*
- **Tongs** *are of tough* **light weight** *alloy.*
- **Copper Jaws,** *quickly and easily* **replaceable.**
- **Insulators:** *New Crown Type with Metal-Clad jaw insulators . . . last many times longer.*
- **Maintenance:** *Replaceable Copper Jaws and Metal-Clad jaw insulators cut maintenance of Jackson Holders 50%.*
- **Ventilation:** *Free flowing . . . no holder works cooler.*
- **New Tong Pivot-Hinge:** *Easily knocked down and assembled.*
- **Cable Connection:** *Mechanical.*
- **Capacity:** *A-4, 1/4" electrodes.* *A-5, 3/8" electrodes.*

Contact your nearest Jackson dealer or write to us.

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The Welding Engineer

Welding • Cutting • Brazing • Flame-Treating • Metallizing

as applied in

Design • Engineering • Construction • Production • Maintenance

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Published on the 1st of each month by The Welding Engineer Publishing Co., 506 So. Wabash Ave., Chicago 5. Phone Webster 7134.

Copyright, 1944, by The Welding Engineer Publishing Co.

Subscription, United States, possessions, and Canada, $3 a year; foreign countries, $4 a year; single copy, 35 cents. Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

FOREIGN REPRESENTATIVES: AUSTRALIA and NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand; BRAZIL—Alpha Jewel, Caixa Postal No. 2411, Rio de Janeiro, Brazil; GREAT BRITAIN—A. D. Baynes, 1 Cambridge Park Court, Twickenham, Middlesex, England; SOUTH AFRICA—J. W. Arnison, 35a Victoria Avenue, Benoni, Transvaal, South Africa; U. S. S. R.—Mesdunarodnaja Kniga-Kusnezki Most 18, Moscow, U. S. S. R.

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WE'LL LET YOU IN ON THE SECRET OF THIS WEAPON

SMITHway Electrodes in action on sections for a SMITHway Multi-Layer Vessel (on the right after machining); 42 inches in outside diameter with 5½-inch wall thickness; for operation in a war plant at 4,500 pounds per square inch.

WHEN the war started, everybody—including the Axis—was sure American industry couldn't build enough high-pressure vessels to produce the immense quantities of explosives necessary for waging global war. There just wasn't enough forging capacity available to turn out these giants, but Multi-Layer welded construction, pioneered by the A. O. Smith Corporation, solved the problem.

What does this mean to you? Just this: if you do big, tough welding jobs, we can supply you with the same kind of SMITHway Certified Welding Electrodes that we use in the production of some of the world's largest, most exacting welding jobs.

SMITHway Certified Welding Electrodes are the best that money can buy because we have a double interest in making them right. No other electrodes go through as thorough production controls—are so scientifically checked and rechecked both in the laboratory and on the production floor.

The code number on every box of SMITHway Certified Welding Electrodes is your assurance that they will give you better welding results at lower costs on the big jobs that you and we call upon them to do. Specify SMITHway Certified Welding Electrodes. Made *by* welders—*for* welders.

Mild Steel . . . High Tensile . . . and Stainless Steel

WELDING ELECTRODES

made by welders . . . for welders

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SMITHway Welding Monitor cuts the time of training welders as much as 33⅓%.

SMITHway AC Welding Machines reduce spatter, completely eliminate "arc blow."

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The Welding Engineer

AMERICA'S PIONEER WELDING JOURNAL

Established 1916

The Right of Free People

There will be a lot of groaning on Wednesday, November 8. Between 20,000,000 and 25,000,000 of the 55,000,000 voters will have the right to bemoan the outcome of the national election because they voted—even if for a defeated candidate. Another group of 10,000,000 to 15,000,000 people, however, will be heard discussing the "cruel choice of the gods" which caused their preferences to fall in defeat. Yet these decriers were simply too busy to vote, and it somehow never occurred to them that the gods have somewhat less to do with electing men to office than John Q. Citizen who mark X's on his ballot.

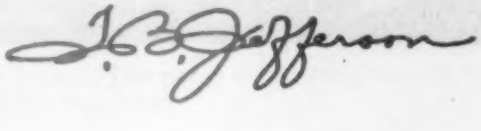
All over the world, fathers, sons, brothers and sweethearts are fighting and dying so that we Americans may remain free. To us, freedom means that each adult can have a voice in our Government and the right to express that voice by voting in the "good" Government he wants and voting out the "bad." Some 88,000,000 citizens are given this privilege, but how many of them will take the trouble to exercise the right? Never more than three fourths, sometimes only half! Yet those who complain the most over the outcome will in many cases be those who did the least to affect it.

Voting takes time—maybe 5 minutes or so! It may also take you a block or perhaps even two blocks off the beaten path of your daily travels. Well, if the right to vote was considered worth dying for by our ancestors at Bunker Hill, Valley Forge and Yorktown, and by their descendants now knocking at the gates of the Rhineland, it is certainly worth walking a short distance and waiting in line for a few minutes!

Just to mark an X isn't enough. You should be sure that the candidate for whom you vote stands for the free way of living you wish to continue to enjoy. So long as he will respect the rights given to us in the Declaration of Independence and the Constitution, it matters little whether he is a follower of the Elephant or a chaser of the Donkey.

Many of you now reading this magazine may have to be away from your normal place of residence on election day. Don't just take it for granted that you won't be able to vote—you may be able to vote by absentee ballot if you still maintain your legal residence at your previous place of abode. Or if you have established a new place of residence, you may vote by becoming properly registered. In either case, find out what action is required on your part to be able to enjoy your franchise privileges. Don't let your ballot go by default if you are legally empowered to cast it.

The important thing for every patriotic citizen to do is —to vote. *How* is your business. The candidate you choose may not be the one I want for president, but your right to vote for him is the most basic of our freedoms. Exercise that right on November 7th!

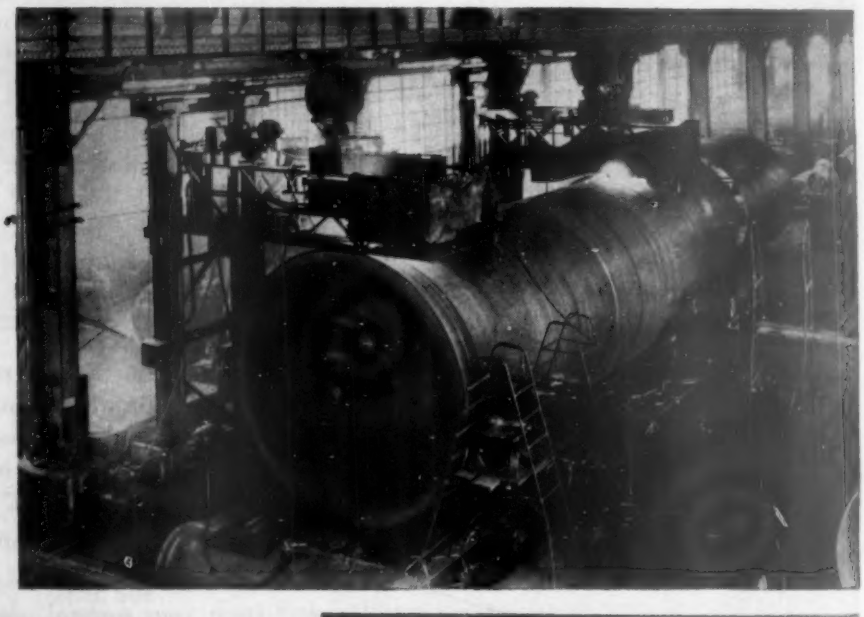


AUTOMATIC WELDING has many advantages in fabricating boiler drums, cracking stills and other products for which repetitive welding is practical. Deposit rate is often greater because of the use of higher currents, and a larger ratio of welding time to working time, compared with manual welding. The strength and high quality of the weld are due to the close control of the arc and the excellent fusion possible at high currents using Murex Electrodes.

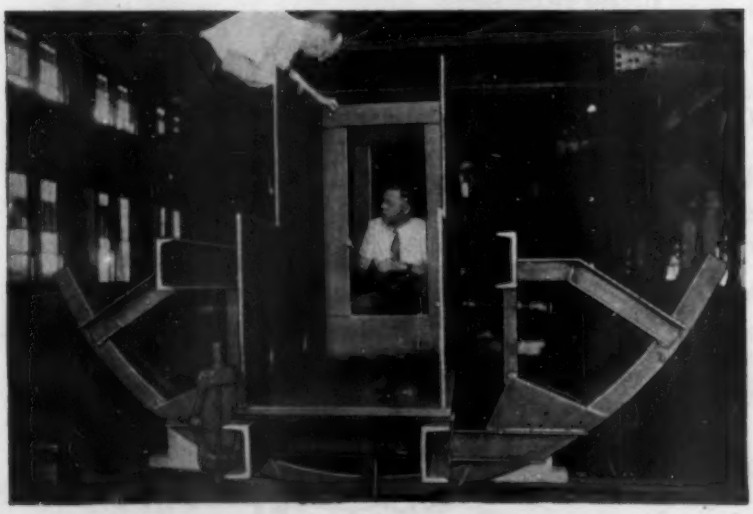
Murex rods available for automatic welding are Type F, Carbon Moly. 50 and Cromansil. The spiral asbestos winding of these rods anchors the coating to the core wire so that the electrodes may be coiled without cracking and also provides an absolutely concentric coating that does not spawl off under the slitter.

THIS STRIKING action photograph illustrates the use of Murex Electrodes in welding the top member of a single action, single eccentric press, fabricated by Clearing Machine Corporation. Press frames are positioned with only four turns. The sides weigh from 80,000 to 90,000 lbs. and some plates are 10" thick. Double-Vee welds, back-stepped, are employed.

HUGE PRESSURE VESSELS over 6' in diameter, up to 35' long and having a shell thickness of 4" to 5" are welded automatically by Foster Wheeler Corporation with Murex Type F and Carbon Moly. 50 electrodes in continuous coils. The soundness of the weld metal is shown by the fact that as many as 44 longitudinal boiler drum seams have been welded consecutively, with only five minor defects showing up under X-ray examination.



CRANE GIRDERS are subject to severe overloads and the shock of sudden stops and quick reversals. Manning, Maxwell & Moore, Inc., applying a special technique, uses Murex Electrodes in the construction of its "Shaweld" crane girders. They are much stiffer laterally than riveted girders and more resistant to the twisting motion set up by the driving machinery. Positioning cradles are used to permit downhand welding on the girders which are exceptionally long and heavy.



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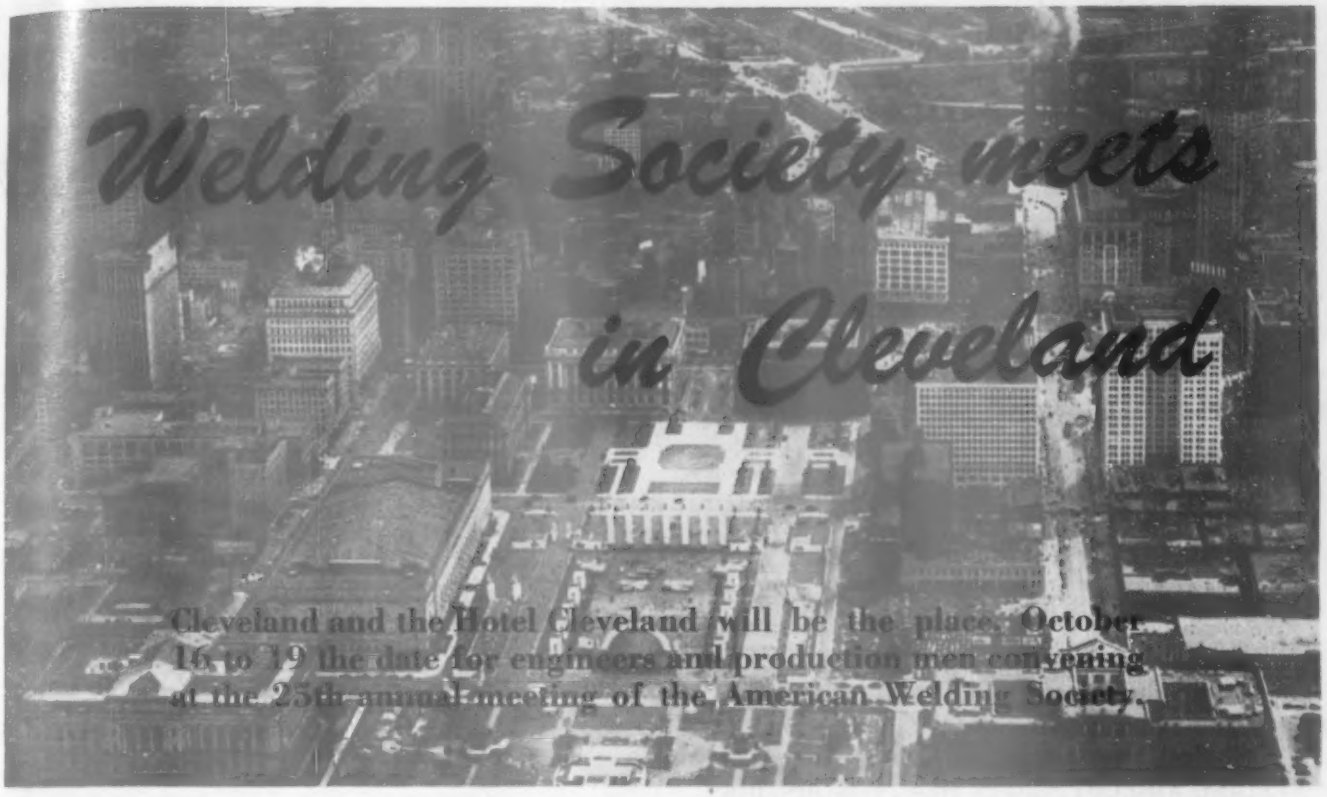
Specialists in welding for nearly forty years. Manufacturers of Murex Electrodes for arc welding, and of Thermit for repair and fabrication of heavy parts.



Welding Society meets in Cleveland

Cleveland and the Hotel Cleveland will be the place, October 16 to 19 the date for engineers and production men convening at the 25th annual meeting of the American Welding Society.

IN KEEPING with its now biennial custom of meeting in Cleveland, the American Welding Society will hold its 25th annual meeting in this city from October 16 to 19 inclusive. As before, convention headquarters will be in the Cleveland Hotel.

The annual meeting will be called to order on Monday morning, October 16, by David Arnott, retiring AWS president. At the opening session the American Welding Society will be presented with the Ordnance Distinguished Service Award for the work it has done in promoting the production of needed ordnance equipment. The usual annual presentation of medals and prizes will be followed by three talks emphasizing the importance of welding in meeting the nation's wartime production needs.

Four other technical societies—the American Society for Metals, the Iron and Steel and the Metals Divisions of the American Institute of Mining and Metallurgical Engineers, the American Industrial X-ray and Radium Society and the Society for Experimental Stress Analysis—will be meeting in Cleveland at the same time as the American Welding Society. All of these organizations are participating in the National Metal Show (see page 64).

Like previous wartime conventions, this year's welding meeting will be stripped of non-essential activities. Social functions which in the past have enlivened these gatherings of welding engineers and production men have been eliminated so that the convention visitors may concentrate their thinking on the many important welding problems created by the imminent return of war industries to peacetime production. It will not be a convention for the light-minded. The tentative program calls for 18 technical sessions, at which there will be presented 59 papers covering all phases of welding and cutting. Special emphasis is being placed on resistance welding, aircraft welding and research—each of these subjects will be discussed at two or more technical sessions.

The simultaneous technical sessions begin on Monday afternoon and will continue morning and afternoon until Thursday noon. The annual business meeting will be held Thursday afternoon and will be followed by the board of directors' meeting, concluding the program.

A few words more should be said about the technical papers to be presented. Covering the entire range of applications of welding and its related processes, the papers will, of course, emphasize present wartime applications. However, most of the wartime welding developments will be applicable in some form or another to peacetime production. The men who have prepared papers represent the thinking of those interested in production, supply, engineering and research.

On Monday evening the second annual Adams Lecture will be delivered. The speaker is Dr. A. B. Kinzel, Union Carbide and Carbon Corp., and the subject of his lecture will be "Solid Phase Welding." On Tuesday evening the University Research Conference will convene, while Wednesday evening will be devoted to the Society's section officers' dinner and conference.

The president of the American Welding Society will give his annual report at the business meeting taking place at 2 p.m. on Thursday. At this time, too, the 1944-45 officers will be installed. Immediately following the business meeting, the annual meeting of the board of directors will bring to a close what will undoubtedly prove to be a highly informative week.

The tentative program of the 25th annual AWS meeting is reproduced in full on the pages that follow.

In keeping with its wartime policy, the International Acetylene Association will convene for its annual business meeting and luncheon during the same week. The meeting will be held at the Euclid Room, Statler Hotel, at 12 noon on Wednesday, October 18. The program will include a report of officers and committee chairmen, the election of officers and chairmen for the coming year, and an interesting talk on pertinent aspects of current events. The name of the speaker will be withheld for the time being.

Welding Society meets in Cleveland

Program of

Monday, October 16

9:30 A.M.—Monday Morning—Opening Session

Chairman: DAVID ARNOTT, President, American Welding Society. Vice-Chairman: E. V. DAVID, Chairman, Convention Committee.
Presentation of Medals and Prizes.

WELDING AIDS THE WAR EFFORT

"Welding as an Aid in Shipbuilding Construction," by Admiral H. L. Vickery, U. S. Maritime Commission.
"Welding as an Aid in the Fabrication of Ordnance Equipment," by Col. S. B. Ritchie, Office, Chief of Ordnance.
"Welding in Aircraft Construction," by W. B. Stout, Consolidated Vultee Aircraft Corp.

2:00 P.M.—Monday Afternoon—Simultaneous Technical Sessions

WELDING AND CUTTING IN HEAVY INDUSTRIES

Chairman: R. J. YARROW, Republic Structural Iron Works. Vice-Chairman: J. M. DRISCOLL, Air Reduction Sales Co.
"Fundamentals of Heavy Cutting," by G. L. Walker and H. G. Hughey, Air Reduction Sales Co.
"Steel Mill Maintenance," by E. W. Gruber, Wheeling Steel Corp.
"Unusual Applications of Gas Cutting in Ordnance Fabrication," by C. M. Underwood, Northern Ordnance, Inc.
"Procedure Control of Automatic Welding Processes," by A. E. Bedell and J. B. Quigley, Graver Tank & Mfg. Co., Inc.

RAILROAD AND TRANSPORTATION

Chairman: J. W. SHEFFER, American Car and Foundry Co. Vice-Chairman: A. G. OEHLER, *Railway Age*.
"Welding of Aluminum Tank Cars," by A. H. Woollen, Railroad Sales, Aluminum Co. of America.
"Railroad Welding," by John McMullen, Erie R. R.

WELDABILITY

Chairman: A. B. KINZEL, Union Carbide & Carbon Corp. Vice-Chairman: C. H. JENNINGS, Westinghouse Electric & Mfg. Co.
"Welding of Manganese Steels," by W. B. Brooks and A. G. Waggoner, Cramp Shipbuilding Co.
"High Tensile Manganese-Silicon Steels for Welded Fabrication," by G. G. Luther and F. H. Laxar, Naval Research Lab.
"The Bead-Weld Nick-Bend Test for Ductility," by C. E. Jackson and G. G. Luther, Naval Research Lab.
"The Influence of Minor Variables of Weldability," by R. D. Stout, S. S. Tor and G. E. Doan, Lehigh University.

8:00 P.M.—Monday Evening—Adams' Lecture

Chairman: WENDELL F. HESS, Rensselaer Polytechnic Institute. Vice-Chairman: R. H. ABORN, U. S. Steel Corp.
"Solid Phase Welding," by A. B. Kinzel, Union Carbide & Carbon Corp.

Tuesday, October 17

9:30 A.M.—Morning—Simultaneous Technical Sessions

RESISTANCE WELDING

Chairman: L. C. BIBBER, Carnegie-Illinois Steel Corp. Vice-Chairman: G. N. SIEGER, S.M.S. Corp.
"Spot Welding Machines for Heavy Gauges of Ferrous and Non-Ferrous Metals," by Mario Sciaky, Sciaky Bros.
"Heat Transfer across Contact Surfaces," by W. B. Kouwenhoven, Dean, School of Engineering, Johns Hopkins University.
"Problems in Spot Welding Heavy Mild Steel Plate," by F. R. Hensel, E. I. Larsen and E. F. Holt, P. R. Mallory & Co., Inc.

RESEARCH

Chairman: S. L. HOYT, Battelle Memorial Institute. Vice-Chairman: R. E. KINKEAD, Consulting Welding Engineer.
"The Effect of Postheating in Welding Medium Alloy Steels," by M. A. Pugacz and G. J. Siegel, Naval Research Laboratory.
"Stress Relieving Study," by Prof. J. R. Stitt, Ohio State University.
"The Effects of Metallurgical Changes Due to Heat Treatment upon the Fatigue Strength of Carbon-Steel Plates," by W. H. Bruckner, and W. H. Munse, University of Illinois.

STRUCTURAL

Chairman: A. S. Low, The Austin Co. Vice-Chairman: J. F. MAINE, Republic Structural Iron Works.
"Standard Details for Welded Building Construction," by H. W. Lawson, Bethlehem Steel Co.
"Field-Welded Pressure and Variable Volume Storage Tanks," by Fred L. Plummer, Hammond Iron Works.

2:00 P.M.—Tuesday Afternoon—Simultaneous Technical Sessions

RESISTANCE WELDING

Chairman: R. E. POWELL, Western Electric Co. Vice-Chairman: H. C. COGAN, National Electric Welding Machines Co.
"Low-Reactance Cable for Portable Resistance Welders," by Myron Zucker, Mackworth G. Rees, Inc.
"The Flash Welding of Alloy Steels—Welding Techniques and Variables," by J. J. Riley; "Metallurgical and Physical Characteristics," by J. C. Barrett, Taylor-Winfield Corp.
"Small Portable Condenser Welding Set," by E. M. Callender, E. G. Budd Mfg. Co.

RESEARCH

Chairman: H. C. BOARDMAN, Chicago Bridge & Iron Co. Vice-Chairman: G. V. SLOTTMAN, Air Reduction Sales Co.
"Some Recent Developments in Stainless Steel Welding," by D. L. Mathias, Metal & Thermit Corp.
"Bi-axial Fatigue Strength of Low-Carbon Steels," by George K. Morikawa and LeVan Griffis, Illinois Institute of Technology.
"Intergranular Corrosion of Stainless Steel Welds," by Wm. T. Tiffin, University of Oklahoma.
"Weldability Tests of Cast Steel," by C. E. Jackson and F. S. McKenna, Naval Research Lab.

SHIPS

Chairman: J. L. WILSON, American Bureau of Shipping. Vice-Chairman: S. A. MIDNIGHT, American Shipbuilding Co.
"Controls Required for Safe and Economical Construction of Welded Ships," by D. G. Maxson, Welding Consultant, Marinship Corp.
"Technical Control of Welding in Ship Construction," by M. H. MacKusick, California Shipbuilding Corp.
"Evolution of Welding in Shipbuilding," by M. N. Maltseff, Western Pipe and Steel Co.
"Multiple and Stack Machine Cutting," by A. H. Yoch, Air Reduction Sales Co.

8:00 P.M.—Tuesday Evening—University Research Conference

of the 25th Annual Meeting

Hotel Cleveland, Cleveland, Oct. 16-19

Wednesday, October 18

9:30 A.M.—Morning—Simultaneous Technical Sessions

AIRCRAFT

Chairman: G. S. MIKHALAPOV, National Research Council. Vice-Chairman: C. W. DODGE, Sciaky Bros.

"Impact Strength of Arc-Welded Joints in Aircraft Steel," by H. O. Klinke, Republic Aviation Corp.

"Helium-Shielded Arc Welding of Exhaust Collector Rings," by Francis H. Stevenson, Lockheed Aircraft Corp.

"Multi-Arc Welding of Aluminum Alloys," by M. R. Rivenburgh and C. W. Steward, Curtiss-Wright Corp.

RESEARCH

Chairman: ISAAC HARTER, the Babcock & Wilcox Co. Vice-Chairman: E. R. SEABLOOM, Crane Co.

"Weldability—as-Rolled vs. Heat-Treated High Strength Constructional Steels," by Lt. S. A. Herres and W. L. Warner, Watertown Arsenal.

"The Effect of Time and Temperature on the Relief of Residual Stresses in Low-Alloy Steels," by J. K. McDowell and Paul C. Cunnick, Lt. Col., Ordnance Dept., Rock Island Arsenal.

"Development and Application of Modern Heavy-Coated Arc-Welding Electrodes," by D. C. Smith and W. G. Rinehart, Harnischfeger Corp.

AIRCRAFT

Chairman: G. O. HOGLUND, Aluminum Co. of America. Vice-Chairman: E. S. JENKINS, Curtiss-Wright Research Laboratory.

"The Geometry of a Spot Welding Tip and Its Relation to Tip Life," by E. D. Crawford and C. W. Steward, Curtiss-Wright Corp.

"Survey of Chemical Cleaning Practices for Spot Welding Aluminum Alloys," by F. M. Morris, Kaiser Cargo, Inc., Fleetwings Div.

"An Evaluation of Process Control of Aircraft Welding," by P. H. Merriman, The Glenn L. Martin Co.

"Characteristics of Welding Arcs on Aluminum in Atmospheres of Helium and Argon," by F. A. Wassell, General Electric Co.

MACHINERY

Chairman: A. E. GIBSON, Wellman Engineering Co. Vice-Chairman: R. J. KRIZ, The James H. Herron Co.

"Production Problems and Production Control," by E. C. Brekelbaum, Harnischfeger Corp.

"Routine Inspection and Salvage of Machinery Weldments—Rough, Partially Machined and Machined," by James W. Owens, Fairbanks, Morse & Co.

"Welded Jigs and Fixtures," by A. N. Kugler, Air Reduction Sales Co.

"Design of Welded Machinery," by John Mikulak, Electric Machinery Manufacturing Co.

2:00 P.M.—Wednesday Afternoon—Simultaneous Sessions

PIPING AND PRESSURE VESSELS

Chairman: A. C. WEIGEL, Combustion Engineering Co. Vice-Chairman: R. W. EMERSON, Pittsburgh Piping & Equipment Co.

"Pressure Vessel Welding," by Edward B. McGuire, Hamler Boiler & Tank Co.

"Normalizing of Welds in Carbon-Molybdenum Pipe by 60-Cycle Induction Heating," by I. A. Rohrig and D. H. Corey, The Detroit Edison Co.

"Properties of Welded Joints between Dissimilar Metals," by E. C. Chapman and R. E. Lorentz, Combustion Engineering Co.

"Oxy-Acetylene Pressure Welding," by A. R. Lytle, Union Carbide & Carbon Res. Labs.

6:30 P. M.—Wednesday Evening—Section Officers' Dinner and Conference

Thursday, October 19

9:30 A.M.—Morning—Simultaneous Technical Sessions

FOUNDRY

Chairman: L. A. DANSE, Cadillac Motor Car Div. Vice-Chairman: AUSTEN J. SMITH. The Lunkenheimer Co.

"Arc-Welding Practices in the Steel Foundry," by Frank Kiper and Lawrence Gabes, Ohio Steel Foundry.

"Machine Cutting of Risers, Flame Scarfing to Remove Padding and Flame Gouging to Remove Webs and Defects," by G. E. Bellew, Air Reduction Sales Co.

"Repair of Castings," by L. A. Danse, Chairman, G. M. Metallurgical Committee, General Motors Corp.

MISCELLANEOUS

Chairman: W. E. CRAWFORD, A. O. Smith Corp. Vice-Chairman: A. L. PFEIL, Universal Power Corp.

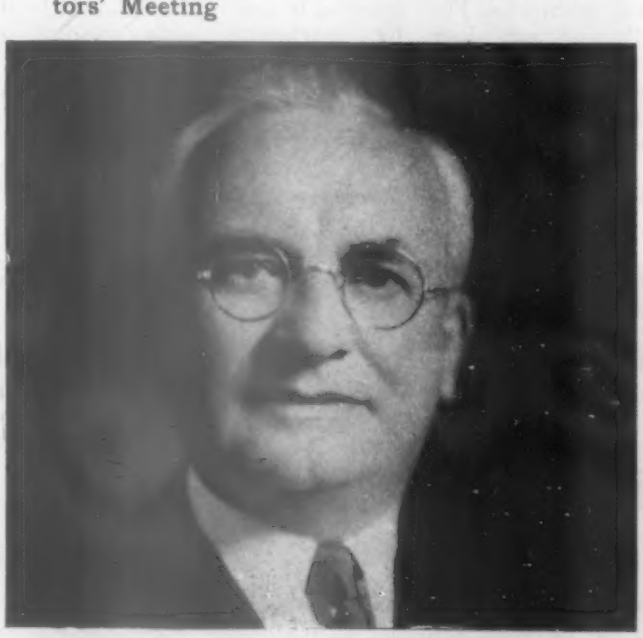
"Low-Temperature Joining," by W. D. Wasserman and C. E. Swift, Eutectic Welding Alloys Co.

"A Method for Measuring the Bond Strength of Sprayed Metal Coatings," by Kenneth Wilson. Metallizing Engineering Co.

"How Much Ductility Is Necessary for Structure or Machine?" by W. J. Conley, Lincoln Electric Co.

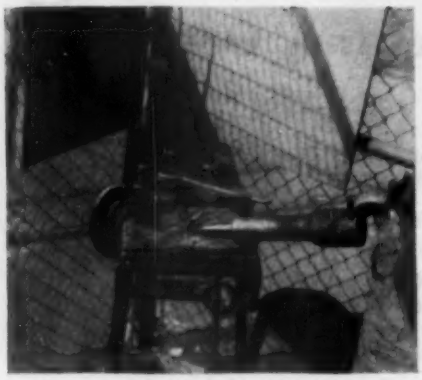
2:00 P.M.—Thursday Afternoon—Business Meeting

3:00 P.M.—Thursday Afternoon—Board of Directors' Meeting



DAVID ARNOTT, *retiring president of the American Welding Society*

Qualification Test Specimens



The preparation of specimens from weldors' test plates is no small job when something like 300 to 450 coupons have to be cut and finished daily. This article gives details of the three chief methods—machining, flame-cutting with hand grinding and abrasive cutting wheels.

By **R. V. ANDERSON**

Fig. 1—Removing the back-up plate with a pneumatic chipping hammer.

VARIOUS agencies and bureaus have set up qualification tests to qualify weldors for various types of production work. Certain physical tests are required; *i.e.*, tensile tests, face, side and root bends, nick breaks, etc. These tests are sometimes amplified by hydrostatic tests and macro-etched specimens.

X-ray inspection is useful as a means of determining the soundness of welds and their freedom from gas and slag pockets. Nevertheless, there are problems of ductility, strength, character of deposited metal and completeness of fusion that would seem to require destructive testing before final judgment may be passed. For this, it is necessary to remove test coupons from weldors' qualification test specimens. The removal is usually accomplished by machining methods, and in the case of plate of heavy thickness this would seem mandatory. However, there have been developed other good methods.

The data set forth here were obtained as the result of the preparation and inspection of over 250,000 test coupons.

The All-Machined Specimen

The machining operations start after test specimens have passed the visual or appearance test. When a back-up strip has been used, the first operation is usually to remove it. After the back-up strip has been machined off, coupons may be cut from the plate by a power hacksaw. If the coupons are saw cut, the weld bead may be milled off in a milling machine, but if the coupons have been flame-cut from the test section, the heat-affected zone from the cutting operation should be removed by a shaper.

For reduced-section tensile tests, the reduced-section specimen may be made either by milling with an end mill or by using a drill of the diameter of the reduced section to drill the edge of the specimen. The use of a drill jig will greatly facilitate this operation.

The sharp edges of the coupons are removed by touching them lightly on a grinding wheel. The surfaces are polished by using cloth wheels impregnated with sodium silicate and coated with abrasive grains. By using 110 to 220 mesh abrasives, various finenesses and degrees of finish may be obtained.

Naturally, it is necessary to have several of each of the machines mentioned in order to prepare 300 to 450 coupons daily. For comparison, if 50 operator qualification tests are anticipated for an 8-hour shift, the total for the 24-hour period would be 150. The 150 tests would require from 300 to 450 coupons to be cut and machined for testing during a 24-hour period. To prepare this many all-machined coupons in 24 hours would require equipment costing around $50,000. The outlay for machinist labor and supervisory control would probably run in excess of $9,500 per month.

Flame-Cutting Method

An alternative method is suggested for plants which cannot afford to make this capital expenditure or which do not have a sufficient volume of operator qualification tests to warrant it. This method employs air hammers, oxy-acetylene flame-cutting machines and small grinders.

In using the second process, the first step is to remove the back-up strip from the test sections. This is done by clamping the test section in a jig and using a chipping hammer to remove the strip from $\frac{1}{32}$ to $\frac{1}{16}$ above the plate line (see Fig. 1). The weld bead is removed in the same way.

Fig. 2 (left)—A portable motor-driven flame-cutting machine is being used to cut test coupons.

Fig. 3 (right)—The final flushing of the weld bead is done by a small air-driven grinder.

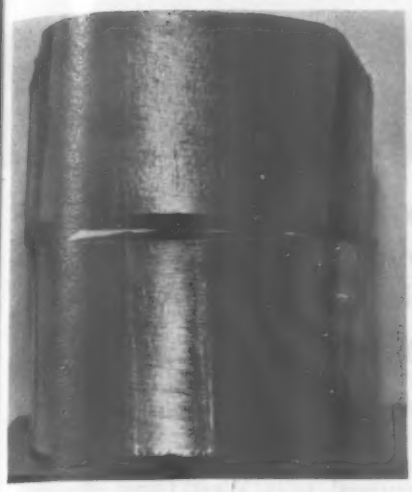


Fig. 4—Face and root bends prepared by the flame-cutting method.

The coupons are flame-cut from the test section by using a portable motor-driven cutting machine as shown in Fig. 2, after which they are placed on a rack (right of Fig. 2) to cool. Each coupon is then touched lightly on a heavy-duty grinding wheel in order to bring the chipped weld bead down to the plate line. The final flushing of the weld bead is accomplished on a small-diameter grinding wheel mounted on an air grinder (Fig. 3). The sharp corners are also removed in the last operation. If a higher finish is desired, cloth and impregnated buffing wheels may be used.

Cost Comparisons

The second method may be carried out with tools that are already available or are obtainable at comparatively low cost. Thus most of the capital investment necessary for the all-machined method of preparation is eliminated. For the same daily volume of 300 to 450 test specimens, the labor and supervisory cost for the flame-cutting method will average about $1,500 a month. This reflects a saving of approximately $8,000 a month over the all-machined method.

The quality of test specimens, if carefully prepared, seems to equal the quality of machined specimens. Face and root bends prepared by the flame-cutting method are shown in Fig. 4.

Abrasive Cutting Wheels

Abrasive grinding and cutting wheels make possible a third method for the preparation of test specimens, a method that has many advantages.

On a ⅜ in. plate thickness, the abrasive cutting wheel operates at about the same cutting speed as a flame-cutting machine. Cutting cost is probably about the same for the abrasive wheel as for oxy-acetylene cutting. There is an advantage, however, in using the abrasive cutting wheel: a finished cut can be obtained that is nearly equal to good machining plus polishing. This is particularly true if the wheels are run with a water spray.

There are many types and adaptations of machines for using abrasive cutting and grinding wheels. Some work on individual carriages, simulating a flame-cutting machine; others operate from an overhead angle, simulating a wood-working cut-off saw.

Details of Procedure

In preparing Q1 weldors' qualification test plates, a 2 in. abrasive wheel mounted on a mandrel is first used to bring the weld bead flush with the plate thickness at the point where the coupons are to be cut. This operation is shown in Fig. 5.

After the weld bead has been removed to the plate line, a ⅛ in. wheel is inserted to cut the test coupons.

Various fixtures and jigs are used for grinding the weld bead and for cutting the coupons. Fig. 6 shows the cutting of coupons for the 2½ in. high-pressure pipe test.

As the plate thickness increases, it is necessary to use a step-back method of cutting. This applies particularly to test coupons from a Q2 weldor's qualification test plate. In some cases it is more advantageous to grind off the weld bead after the coupons are cut than before because this procedure means the removal of less weld metal and gives a better finish to the coupons. The cutting of a Q2 qualification test plate in which the weld bead has not been ground flush is shown in Fig. 7.

In order to grind the weld beads flush for pipe qualification tests, the pipe may be mounted in a roller jig and rotated against the 2 in. abrasive wheel, or the coupons may be cut and the weld bead removed with a small-diameter grinding wheel as previously described.

Like the flame-cutting procedure, the use of abrasive cutting and grinding wheels also eliminates the large capital investment required to produce the all-machined specimens, and work of the same quality is obtained. In many cases the finish produced by the abrasive cutting saw is of such nature that a direct etching may be made after cutting without doing additional polishing.

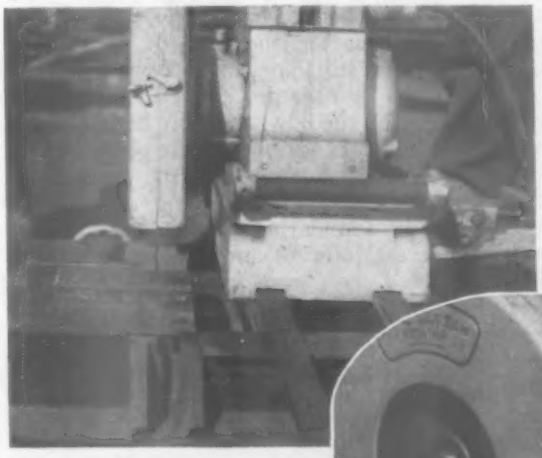


Fig. 5 (left)—Another method of preparation employs a 2 in. abrasive wheel to grind the weld bead flush.

Fig. 6 (below)—Here an abrasive cutting wheel is used to cut coupons for the 2½ in. high-pressure pipe test.

Fig. 7 (left)—This qualification test plate is cut with an abrasive cutting wheel before the weld bead has been ground flush.

Welding Cheats

This saga of the sea is a concrete example of the job the Puget Sound Navy Yard is doing to keep Uncle Sam's fighting ships in the fight.

By **T. B. JEFFERSON**

Fig. 1—Her entire bow shot away in a battle in the Southwest Pacific, the cruiser USS New Orleans is shown here in the condition she reached Tulagi Harbor.

Official U. S. Navy photo.

BACK on the night of November 30, 1942, the Japs were attempting to reinforce their besieged garrison on Guadalcanal, where the Marines had taken over only a few months previously. The Jap force was believed to consist of several transports and supply ships, which were protected by at least eight destroyers and possibly several cruisers. An American task force of five cruisers, including the *Minneapolis,* the *Pensacola,* the *Northampton* and the *New Orleans,* intercepted the Jap force and slugged it out with them in the Battle of Tassafaronga.

Shortly before midnight, in extreme darkness and a calm sea, the enemy was located. American destroyers fired torpedoes, which were followed by salvos from the main batteries of the whole force. In a trifle over ten minutes, the *New Orleans* and her sister ships had sunk one enemy cruiser, three destroyers and one destroyer that had been converted into a cargo ship.

Victory at a Cost

During the firing, however, the *New Orleans* sustained severe damage forward of her bridge. An enemy torpedo hit on her port side between turrets 1 and 2 caused the magazine forward and thousands of gallons of gasoline to explode. The hull forward of No. 2, about one-fourth of the ship's length, was torn off by this triple explosion. Nevertheless, the fact that there were three explosions undoubtedly saved the ship.

When the torpedo struck, two thousand tons of bow and guns sagged down, starting the *New Orleans* on her way to the bottom. Explosions two and three blasted this dead weight away from the hull, permitting the portion left afloat to regain enough buoyancy to remain above water.

The severed bow, its three guns pointing skyward, floated aft along the port side, crashed into the hull and damaged one of the propellers. The ship's commanding officer, Captain Clifford H. Roper, reported seeing the bow of his cruiser sink off the port quarter, the guns of the No. 1 turret still pointing skyward. The *New Orleans* quickly settled some 12 feet by the bow, and only heroic work by officers and men made possible her salvage. Fortunately, the remaining bulkheads held, keeping the vessel from foundering. In the engagement several officers and a number of enlisted men were killed and an additional group were reported wounded or missing, over 200 casualties in all.

Steering under Difficulties

Afire and half sinking, the severed ship (Fig. 1) withdrew from the action and set a course for Tulagi on Florida Island, north of Guadalcanal. The blast had disrupted the communication system as well as the steering and pilot house controls, but the ship's officers and crew were veterans of other engagements and immediately set to the task of repairing battle damage. Only brave and determined men could have kept such a ship on her course. Torn pieces of the hull extended forward; the ship was almost unmanageable and steering had to be done through the three remaining propellers. Only the forward exposed bulkheads kept the sea from pouring in. At one time the pilot tried to head the ship astern in order to lessen pressure on these bulkheads, but this did not prove satisfactory.

In spite of all obstacles, the cruiser, aided by a destroyer, was worked toward Tulagi Harbor. There it was apparent that the vessel had to be returned to a West Coast shipyard for complete repairs. Plans for receiving the ship in this country were made immediately since many weeks of valuable time could be saved if the various repair parts were assembled and ready to go onto the *New Orleans* when she arrived.

The repair operation was to include the following three main phases: (1) construction of a new bow; (2) replacement of all auxiliary machinery in the original bow of the vessel, including the anchor windlass, etc.; (3) installation of a new No. 1 turret. But before any of these steps could be taken, the *New Orleans* had to be made seaworthy for a 1,700 mile trip to Sydney, Australia, the nearest port where a temporary bow could be fitted on her for the really long voyage across the Pacific.

Jungle Shipfitting

It was here that traditional Yankee ingenuity was called upon to do its

Fig. 2—In Sydney, Australia, the New Orleans was fitted with this snub-nosed temporary bow for her long, long trip across the Pacific.

Official U.S. Navy Ph

utmost. Large trees were cut down and floated to the vessel. The logs were used for shoring up bulkheads while the limbs and leaves served to cover the topside to camouflage it from scouting Jap aircraft. Divers, practically naked, wielded underwater cutting torches to remove the flared and twisted plates and the dangling keel which had made steering so difficult.

Fresh water for these jungle shipwrights was obtained from a pipe running back to a mountain stream. Even under these conditions, water was scarce, and the crew took advantage of tropical rainstorms to get their much-needed shower baths almost every afternoon.

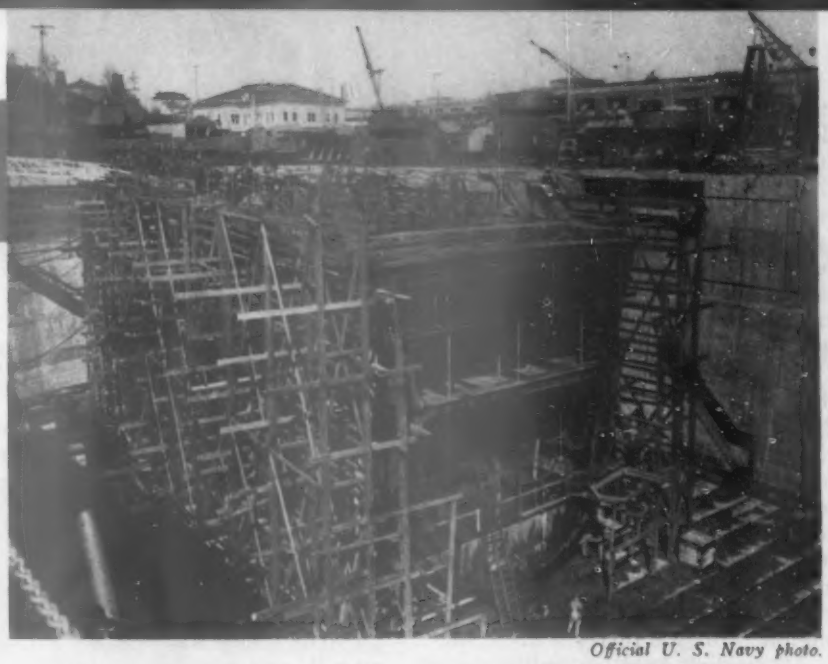
After twelve days of tireless work, under exceedingly difficult conditions, the *New Orleans* was able to make the long trip to Australia. Two destroyers acted as escorts, one of these being the *USS Shaw,* which had suffered similar damage at Pearl Harbor. Slowly the bowless cruiser made her way southward. At one time it was necessary to run her in reverse—stern first at 3 knots for 30 hours—because a narrow channel had forced her pilot to take a course directly into the wind and sea.

In the Meantime—

Back in the United States, full information regarding the battle damage sustained by the *New Orleans* was received at the Puget Sound Navy Yard, Bremerton, Wash. The calamitous report stated that everything forward of a certain specified frame, close to the position of the No. 2 turret, had been lost and that the damage in some places extended further aft. With this information at hand, it was decided that the planning and construction of a new bow could be started immediately.

A sister ship of the *New Orleans* had been built in the Puget Sound Navy Yard so that plans were available to construct the new section.

While the damaged ship underwent temporary repairs in Australia and crossed the Pacific, her new bow was being prefabricated by the shipfitters at Puget Sound in several subsections. These were then moved into a drydock to be assembled. The actual construction of the prefabricated bow presented no particular problem inasmuch as it was a standard shipbuilding job.



Official U. S. Navy photo.

Fig. 3—The new prefabricated bow. This section was being built and assembled at the Puget Sound Navy Yard while the New Orleans was moving across the Pacific.

Jerrybuilt Bow

While this work was going on in Bremerton, another bow—a blunt, wedge-shaped temporary one—was being constructed in Sydney. This temporary affair was built from whatever was available—some of the interior bracing was formed from angles, light rails, etc. of Jap materials captured at Tulagi. When the *New Orleans* steamed into harbor at Sydney, a lightweight welded bow was ready and waiting for her. This was fitted and welded in place as shown in Fig. 2. The *New Orleans* was again ready for sea and was capable of making 15 knots. Soon she was off for Puget Sound.

The *New Orleans* limped toward home, taking several weeks as might be expected. Finally, she reached the Puget Sound Navy Yard after a trip that had carried her, seriously damaged, through nearly 10,000 miles of enemy-infested waters.

American manufacturers and Navy Yard workers had been preparing for her return and were ready to go to work the instant she reached the drydock. Ninety per cent of the new bow had been prefabricated, as most of the structural steel and steel plate had either been in stock or could be readily procured from steel mills. The new bow as it appeared while in the drydock is shown in Fig. 3.

Uniting the Two Sections

The choice of the particular frame selected for the ending of the prefabricated bow proved to be a wise one. The structural design was such that both sections could be brought together for joining with a minimum of complicated work and lost time. It was first necessary, however, to cut away part of the temporary bow which had been built onto the damaged ship at Sydney. Although there were many problems to be encountered in preparing and docking the sections, all obstacles were overcome without any serious loss of time.

The damaged ship was floated to its proper position in relation to the newly built section as shown in Fig. 4. All damaged material was cut and cleared away, and a section was then built to bridge the gap between the old and the new portions. It was found that the shipbuilders in the South Pacific had installed a watertight bulkhead; this proved very advantageous since it enabled the Yard workers to cut off the stub bow just forward of the desired frame and still have the ship remain watertight from that point to the stern.

Alignment Guides

In order to be certain that the two portions of the ship could be made to line up easily and properly, guides were installed on the forward end of the ship and on the after end of the prefabricated bow. These were carefully aligned and distanced so that the two adjoining sections would be at a correct distance from each other and the center lines of the two portions of the ship would coincide. The guides also proved important in reducing the movement or roll of either section while the work progressed.

Certain details of construction of the material filling in between the old and new sections presented special problems. The ship structure under turret 2 had been almost completely damaged and had to be cut out and rebuilt. This necessitated a temporary turret support which weighed a great

number of tons. Moreover, it was desirable that the roller path of the turret would remain undisturbed so that it would not be necessary to remove the turret and re-machine the path. The methods used kept the turret foundation within satisfactory limits of alignment when the temporary structure was replaced by the new.

All-welded construction was used throughout except that under turret 2 all bulkheads had one horizontally riveted butt and in the vicinity of the turret all deck plates had one riveted seam athwartship. The welding was completed in the vicinity of the turrets before the riveting was done in order that welding shrinkages would not be reflected in warping or misalignment of the turret foundation.

All welding work, including the attachment of transition material, progressed from aft to the new master butt. The latter was left free until all possible structural welding had been accomplished in the transition section.

Thirty-two weldors were used during the operation of welding the master butt, 16 outside and the same number inside. A map was prepared, and each man was assigned to a designated station on the day before the job began.

Shrinkage Movement

Considerable speculation arose as to whether or not the welding of the master butt would cause the forward portion of the ship to move on the blocks. A special rig was designed and placed in the forward end of the ship to measure any movement that might occur. After the welding of the master butt had been completed, it was found that the new bow did actually move a distance of about ⅛ in.

The longitudinal armorplate ran across the master butt in such a way that no opening in the armor could be left at a desired frame to allow for welding shrinkage. This difficulty was overcome by leaving the armor open at two frames aft of the master butt and leaving all attachments to the armor between three particular frames open. Also, the lock scarf at one of the frames was given a $\frac{3}{16}$ in. opening to permit shrinkage. After the master butt had been welded, the two portions of the butt had moved relative to each other an amount similar to the bow, and the opening left in the armor lock scarfs had been taken up. It was possible to proceed immediately with the welding of the armor.

The remainder of the work of attaching the prefabricated section was a routine matter, and the job was satisfactorily completed in record time. An indication of the speed with which the work moved is illustrated by the fact that it took but two days from the time the ship was originally docked until it had been redocked in its final aligned position for joining of the two giant sections.

New Machinery and Parts

Procurement of the new auxiliary machinery to be installed had begun prior to the cruiser's arrival. This involved the assembly of pumps, fans, motors, ventilating systems, auxiliary turbines, anchors and anchor chain. The most difficult piece of auxiliary machinery to obtain was a new anchor windlass. The Navy Department had a contract with the Lidgerwood Manufacturing Co., New Jersey, for a new anchor windlass intended for battle damage repair, but the work on this had not yet started and it was not scheduled for completion for two years. Nevertheless, in response to emergency demands from the Navy, the Lidgerwood Co. completed and shipped the windlass to the Puget Sound Navy Yard. Spare parts for the windlass soon followed, completing a truly remarkable speed-up job.

In addition to her auxiliary machinery, the *New Orleans* had also lost a considerable number of spare parts. To supply her with a normal stock, the Bureau of Ships was obliged to assemble the equipment from its new construction program wherever the needed parts could best be spared.

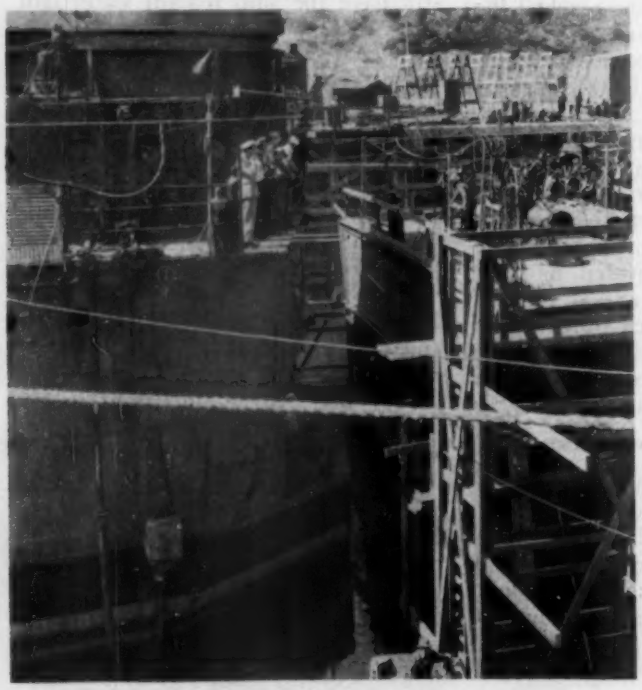


Fig. 4—The damaged portion and the newly constructed bow of the New Orleans as they were brought into alignment. Portions of the temporary snub-nosed bow have been cut away to permit the two big sections to be docked in proper position.

Official U. S. Navy photo.

Switching Gun Turrets

Of the three major repair jobs—fabricating a new bow, installing auxiliary machinery and obtaining a new No. 1 turret—the production and installation of the turret was the most difficult. The Bureau of Ordnance and the Bureau of Ships had under construction at the Mare Island Navy Yard, San Francisco, a spare turret for cruisers of the *New Orleans* class that was intended for battle damage repair. Unfortunately, despite the utmost speed, this spare turret could not be completed in time.

To avoid delaying the *New Orleans'* return to combat, the Navy consulted its records and found that a sister cruiser was due back in the United States for overhaul. The second cruiser was to be overhauled on a schedule which would keep her in the United States until the new spare turret was ready. Accordingly, at the suggestion of the Bureau of Ships and with the approval of the Bureau of Ordnance and the forces afloat, the turret was lifted out of the second cruiser and was installed in the *New Orleans*. The second cruiser afterwards picked up the new spare turret without delaying her return to service.

Finished in Time

In addition to the repair work described, the Puget Sound Navy Yard also completed a large scale overhauling of the *New Orleans*. Notwithstanding this additional work on top of a major repair operation, the *New Orleans* was completed and ready for sea in record time. Credit for the swift repair work should be given to the prefabrication of the new bow, to the rapid assembly and construction of auxiliary machinery and, especially, to the ingenious exchange of turrets between the two cruisers.

The *USS New Orleans* left the Puget Sound Navy Yard fully repaired . . . a faster, modernized, more deadly fighting machine than she was before. Welding played a prominent role in getting her back into action again.

★ PRODUCTION

Spot Welding Armor Plate

A major departure from conventional spot welding is a new control which permits preheating, grain refinement, tempering, forging to be done on the welding machine.

By **FRED A. LEE**

Assistant Supt., Springfield Div., International Harvester Co.

One of the assembly lines of five spot welders to handle the welding of side and rear panels of half tracs at International Harvester.

PAST attempts to use spot welding for the fabrication of heavy sections of alloy steels have been accompanied by enough difficulties to suggest that the process is not readily adaptable to such work. As the result of recent developments in spot-welding techniques, however (including an entirely new conception of welding machine control), International Harvester Co. has found it possible to avoid the limitations previously imposed.

Inspection Simplified

One of the most important results of the development of this new spot-welding technique is that the physical characteristics of the completed weld can be ascertained by merely inspecting the outside surfaces. Relatively untrained operators can thereby inspect the quality of the welds as their machines make them. The improved spot-welding development has proved of major importance to us not only in assuring consistent optimum weld quality but also in speeding production of a large contract for half tracs at our Springfield plant.

Incidentally, the ability to use spot welding with relatively untrained operators saved considerable time—and some $240,000 of cost—in personnel training alone. Thirty-eight of the new-type machines did the job of some 200 arc welders.

The contract involved the production in just one year of thousands of half-trac trucks in three armor-plated body types—anti-aircraft gun mount, machine-gun mount and personnel carrier. The plate panels were to be light gauge, medium carbon, medium alloy steel. To this plate numerous parts had to be attached—door battens, brackets, hinges, latches, etc. These were mostly made of mild steel and varied widely in thickness. To cut production time, I. H. C. decided to try out a new resistance-welding process developed by the Progressive Welder Co.

In this process, the time-honored method of controlling current input to the weld by adjusting the time of current flow is eliminated. The amount of current used is automatically determined by the weld itself—temperature at the weld being the controlling factor. The process also makes possible the complete automatic heat treatment of spot welds right in the spot-welding machine, including both grain-refinement and tempering.

"Measures" Weld Temperature

The control of the process and machines is initiated by a thermocouple embedded in one of the electrodes to "measure" the temperature at the weld. Dials calibrated in degrees of temperature at the weld control the actual functioning of the machines. It is only necessary to set these dials to values corresponding to the consecutive temperatures desired for preheating, welding, quenching, grain refinement, tempering and the various cooling intervals between these heating stages.

The quality of the welds was maintained at a consistently higher level than was demanded by the Ordnance Department. The welds exhibited unusual freedom from blowholes as well as excellent hardness, shear strength, tensile strength and resistance to shock.

An important contributing factor to the speed of production was the refrigeration of the electrodes with brine held at 0 F. Such cooling made possible the successful use of the thermocouple, gave rapid quenching of the welds and helped to maintain electrode shape even at the high welding temperatures, pressures and speeds used, thereby materially reducing the amount of downtime necessary for maintenance.

Visual inspection of the spot welds is made possible by the temper colors which develop during the heat-treating cycles. These temper colors were found to furnish an accurate index to the hardness, strength and degree of grain refinement attained both in the weld proper and in the adjacent metal. It is unnecessary, therefore, to section or break a weld in order to determine its quality, as must be done with welds produced by conventional spot-welding methods.

The importance of this spot-welding development may be more fully realized when it is remembered that in a conventional machine induction losses and the short circuiting effect of previous welds cause variable weld-current losses which vitally affect weld size and quality. Compensa-

tion for such variable conditions in conventional spot welding can be made only on a trial-and-error basis. With the new method of control, however, compensation for such losses is automatic.

Every change in thickness or change in alloy, etc. necessitates a separate trial-and-error adjustment of weld time and current in the conventional spot-welding process. The new process, on the other hand, makes it possible to use the same setting of the control panel to weld a wide range of thicknesses since the controls are actuated by *the actual temperature* at the weld and not by the length of time the current has been flowing nor the total energy input.

Types of Operations

The welding operations at I.H.C. consisted of welding the various mild steel attachments, ranging in thickness from No. 19 up to No. 3 U. S. S. gauge, to the light-gauge panels of plate. Typical welds required were the joining of ¼ in., 3/16 in., ⅛ in. and in some instances a 3/16 in. section of mild steel plus another section of ¼ in. mild steel to the plate. The most frequent weld operation, however, was the joining of 3/16 in. mild steel to the plate panels.

Of the 38 spot-welding machines, 16 are located on the first floor and 22 on the second floor of the plant. The machines on the second floor are used to weld subassemblies which can readily be lifted by the individual operator without the use of a power-lifting device.

First Floor Layout

On the first floor there are three lines of welders, five machines per line, to handle the right and left combined side and rear panels. Each line accommodates the welding of six different types of panels. The right and left panels require different attachments, hence different welding times. In order to balance up the work of welding a complete side panel, it is necessary for one machine to weld ¼ in., 3/16 in., ⅛ in. and 10 gauge mild steel to alloy steel. Some of these spot welds are located on the edge of the plate with practically no material in the throat of the machine; others have a full 24 in. width in the throat.

Left: Starting a weld on a small assembly. Note that the operator has an unobstructed view of the spot welds as they are completed.

Below: Note the variety of attachments welded on this one assembly.

Material Handling

Since many of the parts are relatively large and heavy, it was obviously undesirable to support them manually while the several welds were being made on one machine. Instead of constructing complicated fixtures to support the parts while going through the machines, we developed a simple method of material handling at the welders.

Low-cost wooden tables mounted on castors were notched so that they could be rolled into place around the welder electrode. Simple dolly-type fixtures on castors were provided for the parts themselves. These dollies were adjustable as to height and could be merely rolled across the table to locate the part in the proper height relation with the electrode. With this arrangement, we obtained the same flexibility with stationary welders that is normally available only with permanent fixtures and gun-type welders.

We used roller gravity-type conveyor equipment to convey the larger panels from one machine to the next. Each conveyor has one section of the cross-transfer type designed to raise and lower the panel and to move it at right angles to the electrode. This arrangement permits the movement of large panels in all directions in order to locate the welds. At one station the welding machine is actually suspended from the ceiling with its throat downward; this arrangement permits attachments to be welded to the leg of the L-shaped panels without removing the assembly from the conveyor.

Tilting cross-transfer conveyor sec-

tions are used to hold the assembly at an angle while welding the front end of the panel, which has a 12½ deg break. This permits the horizontal movement of the assembly through the machine.

One machine in each line is set at an angle to the conveyor line in order to clear the turned-up end of the plate forming the rear panel. The remaining machines are set at right angles to the conveyor line. There is in each line one turntable, which permits the panel to be turned end-for-end in order to avoid unnecessary steel in the throat of the welder.

Heat-Treated Spot Welds

In welding the various assemblies, four heating periods with alternating cool periods are employed. The complete cycle is in seven steps:

1. Preheat,
2. Cool and forge,
3. Weld,
4. Cool and forge,
5. Grain refine,
6. Cool and forge,
7. Temper.

Identical pressures are applied to the electrode for all heating periods, but during the cool periods the pressure on the electrodes is increased by approximately 50%. Each heating period is independently adjustable as to the rate of current flow.

Preheat Period

When the two pieces of steel are in position, the machine is started, and the electrodes come together under sufficient pressure to insure proper contact and proper heating. The current continues until the maximum desired temperature has been reached, when it shuts off automatically.

This preheat period establishes an intimate contact between the mild steel attachment and the alloy steel plate and between the electrodes and the work. It also: (1) reduces the proportion of current loss through short circuits through previous welds in the vicinity of the new weld, (2) helps to center the weld nugget directly beneath the electrodes and (3) permits the use of high-power levels in subsequent melting of the nugget.

It has been found most desirable for preheat to use the maximum amount of energy which can be quickly applied without any actual material fusion of the plates. The duration of current flow during the preheat period is from 2 to 3 seconds for the heavy sections being welded.

Cool and Forge

The second stage in the welding cycle is not actually a true cool period although it is commonly known as one. In this period pressure between the electrodes is momentarily increased without current in order to establish a maximum intimacy of contact at the weld. Only a slight amount of cooling is permitted by the thermocouple. This period lasts something less than half a second before the weld current is initiated.

Welding Period

The electrode pressure automatically cuts back to its original setting at the beginning of the weld period. When the preselected weld temperature—somewhat above melting range—has been reached, the control automatically cuts off the welding current. The current intensity is, of course, much higher than during the preheat.

Right: Simple fixtures mounted on casters are used to speedily position the work.

Below: This welder is suspended from the ceiling with its throat opening downward to permit brackets to be attached to the short leg of the L-shaped panel without using a hoist. A section of the gravity-type conveyor is shown in the background.

The weld is usually completed in from 2.5 to 3.5 seconds at the high-current levels used. In general, higher power levels are used for thin attachments than for thick attachments. This tends to displace the heat balance towards the thinner section, thus offsetting the unfavorable geometric center and lower electrical resistance of the thinner mild steel.

At the same instant the weld current is cut off, the electrode pressure is increased to produce a forging ac-

A tilted cross-transfer conveyor is used to hold the "bent" front end of this panel leg in a horizontal position for welding.

tion by squeezing the plastic material in the weld nugget. This pressure is held throughout the entire cool period, which may last approximately 12 seconds for heavy sections.

Cool after Weld

This particular cool period—which is really a quench after the weld—is extremely important to weld quality. Its purpose is to transform the iron in the nugget from the gamma to the cooler alpha condition. The cool period alone permits a martensitic condition to be attained in the weld zone; no external quenching medium is necessary to obtain this result because of the tremendous temperature differential between the heated plate and the refrigerated electrodes cooled by a brine solution of 0 F. The resulting quenching rate is higher than the critical quenching rate of the alloy steel used, and the hardness of the weld zone immediately after this cool period therefore approaches the maximum hardness that it is possible to obtain for the particular carbon content of the steel.

An important metallurgical advantage of using the thermocouple to control postweld cooling is that it insures the proper cooling of the various thicknesses of mild steel attachments and different diameters of welds with the same setting of the control.

Grain Refinement

After the weld has been transformed into martensite by cooling, the electrode pressure is automatically reduced to the same value as used for welding, and current is again applied. When the reheated metal has reached a particular preset temperature, the current again shuts off. The point at which this occurs represents a temperature above the critical range at which the coarse grain structure produced in welding is refined. The grain refinement of even the heaviest sections is usually accomplished in six to seven seconds.

After grain refinement, the current cuts off again and forging pressure is once more applied while the temperature of the weld zone drops below the critical range. Thus the metal is hot worked as it cools through its critical range, permitting the refined grain structure to be retained to an extent that is not always possible even with furnace heat-treating methods. The second cool period brings the weld-zone temperature once more to below the "martensite arrest" point.

Tempering

The final stage is to temper the hard martensite so as to insure adequate impact strength. This is accomplished by applying further current at a relatively low power level. The time required for this is about 3 to 5 seconds with heavy sections. The final hardness of the weld zone approximates the original hardness of the alloy steel.

Visual inspection of the temper color ring at the weld is actually sufficient to determine whether or not that weld is going to meet specifications for hardness, impact resistance, etc. Furthermore, when a temper ring indicates a faulty weld, a trained inspector can usually locate the source of the trouble quite easily by observing the colors assumed by the plates during their welding and grain refinement cycles.

Another visual check is to watch the swing of the galvanometer as the weld passes through the "martensite arrest" point in cooling. At this point there will be an appreciable lag in the rate of cooling, which can be seen by watching the action of the galvanometer. Variations in the time required for the individual heating periods serve as still other indications of possible trouble.

Machine operators can readily become familiar with the simple visual inspection technique, enabling them to discontinue welding at the moment there is any change or fluctuation in the character of the welds being produced. (The actual resetting or correcting of a machine is handled only by the maintenance electricians.) As a result, we need only eight inspectors to check the entire output of the 38 spot welders and adjust the machines when necessary. The accuracy of the visual check, needless to say, has been borne out by repeated sectioning of welds and laboratory analyses.

Welder Control

As previously stated, the operation of the welder is controlled by means of an electronic system actuated by the thermocouple. The thermocouple consists of an iron wire and a constantan wire that have been silver soldered so that the hot junction occurs just below the surface of the lower electrode. Thus located, the thermocouple measures weld-zone temperatures more accurately than it would if the hot junction were placed at the surface.

Since the temperature gradient between the interior of the weld and the surface has been found to remain constant, the galvanometer deflection can easily be calibrated to welding temperature. It should be noted, however, that slight changes of calibration are required as the lower electrode wears down in production operation.

As the weld temperature increases, impulses received from the thermocouple actuate the galvanometer, and the latter deflects a beam of light towards a photo-electric cell. The light rays will impinge upon the cell at the exact instant the weld temperature reaches its selected value. There is then operated a progressive relay which: (1) stops the flow of welding current, (2) operates valves to change electrode pressure, (3) resets the electrical network for the next step in the process and (4) indicates the stage of the complete operation by lights on the control panel. When the weld has cooled to a preselected temperature, a similar action takes place to start the next heat cycle.

An electronic "phase-shift" circuit —which automatically selects a preselected portion of the total current available—makes possible close regulation of the rate of heating. A pick-up coil is placed in the throat of the welder in order to compensate automatically for such variables as variations in power supply, cleanliness of the work surfaces, the amount of metal in the throat of the welder, the number of welds on the piece, etc. The amount of energy picked up by this coil varies in proportion to the change in energy available for actual welding. The energy thus received by the coil is transformed to an element of the "phase-shift" circuit,

where it automatically increases or decreases the weld current as required.

Cooling Equipment

The refrigerating system consists of two 2-cylinder 10 in. by 10 in., 360 rpm compressors designed to operate at 10 lb suction pressure and 185 lb discharge. Each compressor is rated at 52.8 tons of refrigeration—that is, ice-melting duty in 24 hours. Cooling of the compressor and after-cooling of the high-side ammonia gas is accomplished by recirculating the cooling water through an economizer condenser. Treated water is always used in the equipment, maintaining high-heat transfer value at the condenser and compressor cooling surfaces.

Electrode Design and Dressing

The electrodes are made of a standard RWMA group 2 electrode material, which is a copper-base alloy with a Rockwell B hardness of approximately 80 and an electrical conductivity of between 80 and 85% that of pure copper. The upper electrode is 1½ in. in diameter and the lower 2½ in. The contact faces are ⅞ in. and 1¼ in., respectively, in all machines, regardless of the stock being welded. Both electrodes have centered faces.

The above combination of sizes permits the welding of all-flanged attachments, regardless of the plate position outside the throat of the machine, without off-center electrodes. The centered electrode face produces more even heating and cooling in the weld zone, and mechanical dressing can be used instead of hand filing.

In order to maintain the highest quality of welds, it is necessary for the operator to keep his electrodes dressed to the correct diameter and shape and the contacting faces so dressed that the weld nugget will always occur directly between the electrodes. This assures uniformity of grain refinement and tempering during the subsequent heating period.

Electrode Pressures

All of our welding machines are equipped with a hydro-booster actuated dual-pressure system to increase the pressure on the electrodes during the cool periods. The use of increased pressures during the cool periods hot works the metal for grain refinement and also makes it possible to maintain weld diameters slightly smaller than the contact face of either electrode without experiencing porosity in the centers of the welds. The advantage of weld diameters smaller than the contact face is that the plastic area of the weld will not extend beyond the contact face of either electrode.

For the majority of welds, the total electrode pressure is about 7,000 lb during heating and 11,000 lb during the cool period.

Laboratory Testing

Final control of all production resistance welding at the I. H. C. Springfield Division is exercised by the metallurgical laboratory working in close coöperation with a welding engineer. Test welds are required either every 8 hours or every 400 welds, whichever period is the shorter, and whenever a major change is made in the welding machines or their controls. Two test specimens are prepared for each inspection. One specimen is tested for impact strength, weld diameter and grain refinement adjacent to the weld; the other specimen is sectioned and examined for hardness, weld diameter and macrostructure. Weld sections are occasionally examined under the microscope for homogeneity of structure.

The impact specimen consists of a piece of mild steel 3 by 8 by 5/16 in. welded crosswise to a piece of alloy steel of the same size with a single weld in the center of the cross. A piece of mild steel 3 by 8 by ¼ in. is welded on top of the first piece for additional reinforcement, the spot welds being made at the ends of the two mild steel plates. The mild steel is held in the grips of a specially designed impact machine while a U-shaped, 100 lb hammer is dropped from a height sufficient to separate the pieces. The remaining impact energy in the hammer is then measured.

For the hardness test, a piece of mild steel is welded to a test piece of the alloy steel plate. The specimen is sectioned through the center of the weld, polished and then etched to define the macrostructure. Hardness surveys are made, and the laboratory technician adds his interpretation of the macrostructure and hardness.

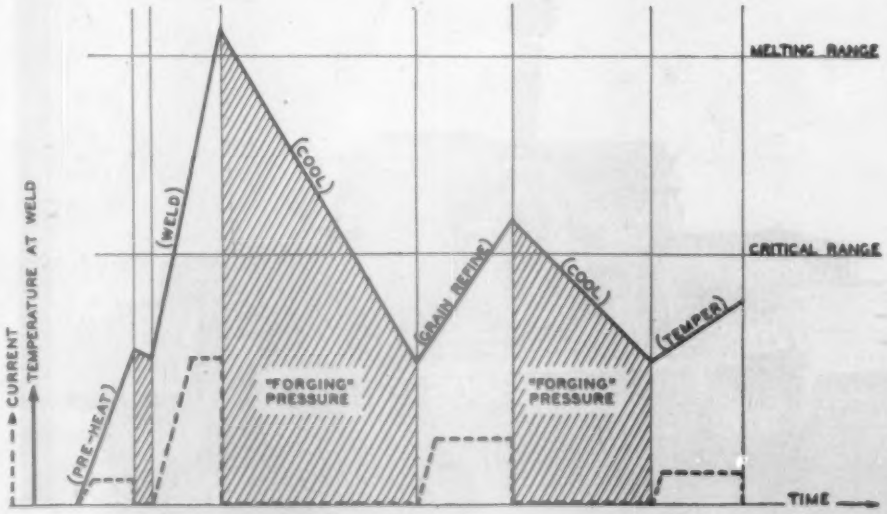
Materials Preparation

The alloy steel used is a medium carbon, medium alloy purchased in the form of heat-treated plates. Since the steel is made and heat treated under very rigid inspection, the metallurgical inspection at International Harvester is limited in general to surface defects and to weldability. The latter is determined by actual resistance welds on test coupons furnished from the various parts being processed. All plates are shot blasted so that no particles of scale will remain on any surface area in the region of a weld.

Commercial quality, hot rolled, pickled and oiled AISI C-1010 semikilled steel is used for the attachments welded to the plate. This steel is checked for surface condition, porosity, carbon content and impact strength by the laboratory before it is released for fabrication into production parts.

The selection of semikilled steel over rimmed steel for these attachments was originally decided upon because the former has a greater uniformity of analysis over the entire width of the sheet. Tests have shown that satisfactory welds can be made with the rimmed steel, but with slightly lower uniformity. However, the equipment installed at the Springfield Division will produce welds capable of satisfactorily passing the required tests in either semikilled or rimmed steel.

This time-and-temperature chart shows the seven stages in the new temperature-controlled spot-welding process. The time for each stage varies automatically with stock thickness, size of plate, throat losses, etc.



Arc Welding Armor Plate

Our British allies have experienced a parallel development in tank construction and now employ many of the processes and procedures used for welding armor in the United States.

By **BRIGADIER W. M. BLAGDEN, O. B. E.***

UP TO the beginning of the present war, the hulls and turrets of British armored fighting machines were made up relatively thin plates of armor, bolted and riveted to a mild steel framework composed of flats and angles. The armor was either of the cemented type, known as C.T.A., having a very hard carburized outer face, or of the homogeneous type, "homo-hard," of uniform hardness and carbon content.

The standard of protection aimed at in those days was designed to provide immunity from attack by armor-piercing projectiles of the small arms class with the thinnest and, therefore, the lightest possible plates. The thickness of vertical armor required to defeat the 0.303 in. and 7.92 mm A.P. (armor-piercing) bullet of those days was of the order of 12 mm of C.T.A. or 14 mm of "homo-hard." Horizontal plates and also any plates which were set at an angle to the vertical might safely be made thinner than this; hence plate thicknesses down to 4 mm were encountered. (Note: 1 mm =0.03937 in.)

Anxiety was never absent as to the possible weakness of joints between plates, but the backing provided by the framework was considered to compensate for this. Apart from keeping out the cores of A.P. bullets, however, it was necessary to keep the molten lead splash from the ordinary ball S.A.A. (small arms ammunition) from getting into the hull; the gap between adjacent plates had, therefore, to be kept down to within very small limits, and this called for extremely accurate profiling of the plates.

The C.T.A. plate would have a hardness value of about 600 Brinell on the outer face and 400 on the inner, whereas the homo would be about 450 Brinell on both sides. Either steel was most troublesome to machine in the hardened state, the C.T.A. being naturally the worst, and the armor plate manufacturers had to install highly specialized machinery for the purpose. This made armor plate costly and difficult to produce. It meant that the shaping of tank armor could only be carried out by those manufacturers who were suitably equipped; consequently, the work had to be confined to the plate-making firms themselves, who had not enough capacity to cater for our enormous re-armament program.

*Reprinted from *Royal Engineers Journal* (Eng.)

Welding Advantages

Welding would remove the need for these close joints, while completely avoiding the possibility of entry of lead splash. It would eliminate rivets and bolts, which, when the plate in their immediate neighborhood is struck by a projectile, are apt to fly inwards at great velocity and cause casualties. Considerable saving of production time and cost would result from flame-cutting the plates to shape instead of machining. Finally, the elimination of a framework would reduce the weight of a completed vehicle.

In spite of these obvious advantages, however, the adoption of welding for tank hulls and turrets in this country was delayed for the following reasons:—

Britain's latest tank, the Centaur, was only recently taken from the secret list so few details are available. The Centaur is a cruiser tank mounting a six-pounder gun. It is described as having a three-man turret.

British Official Photo

British Official Photo

British armor crossing the Sangro (Italy). The heights shown in the background have been in British hands for several months.

(1) It was considered difficult to make a mechanically sound weld in armor plate.

(2) It was feared that the heating of the plate during welding would seriously impair its immunity.

(3) It was considered that the weld metal would be ballistically inferior to the rest of the plate, so that (in the absence of a backing strip) the joints would be more vulnerable than the rest of the structure.

Early Welded Vehicles

In the face of these objections, a start toward the welding of armored fighting vehicles was made in 1939 when welding was used on two armored wheeled vehicles: an armored car and a scout car. Both of these carried "homo-hard" armor of no great thickness. The first intention with regard to the armored car was to build it up in the conventional manner by riveting the plates to a framework and then weld over the joints to make them "splash proof." Thus mechanical strength would be ensured by the framework, and it was hoped that the very light welds used would reduce the immunity of the plate so slightly that the presence of the framework behind the heat-affected zone would fully compensate for the loss.

The scout car was (and still is) an extremely small vehicle with an open top. The body was to be bolted to a chassis frame, which was to supply most of the structural strength. However, the designer of the body, feeling that he could not sacrifice any space or weight to a riveted internal framework, boldly specified welded construction. This got by the General Staff on the pretext that as the vehicle made no claim to giving 100% immunity the ballistic risks involved in the use of welding might legitimately be accepted.

While the specification of these two vehicles was still being argued, a considerable advance was being made in the technique of welding armor plate. When it actually came to manufacture, therefore, the armored car also was given an all-welded body without any riveting or framework; this practice has since been followed in the manufacture of most other British armored cars.

Use Nickel-Chrome-Moly Steel

At the outset of the war the composition of most of our rolled armor plate was of the order of Ni 3.5%, Cr 1.5% and Mo 0.5%, with carbon content about 0.3%. Such a material at the tensile level at which it was used is very unyielding, and it becomes very hard and brittle when cooled in air from high temperatures. In welding two plates of armor together, the weld metal is deposited in a molten state and the joined edges of the plates are made very hot; hence the stresses set up by contraction on cooling cannot be met by the plates without cracking. Cracks usually appear in the junction and fusion zone, but cracks transverse to the welds may form in the body of the plates in the case of a severely restrained structure like the hull or turret. The cracks may not necessarily appear as soon as the weld has cooled but may form later under the influence of stress or vibration.

Electrodes, Jigs, Positioners

The first step towards the solution of this problem had already been made in the Research Department at Woolwich before 1930. It was found that the use of special welding electrodes designed to make an austentic deposit in the weld results in a high degree of ductility at all temperatures below the freezing point. Such a weld, therefore, can yield to the cooling stresses without cracking either itself or the parent plate.

If two plates of armor are welded together at any given angle, the contraction of the weld metal on cooling will cause this angle to change. This must be allowed for in manufacture. It was found possible to provide jigs in the form of frameworks to which the hull plates could be clamped in their correct relative positions during welding.

It is also necessary to arrange the welding technique and procedure in order to control the distortion and cracking of welds; this involves the method of building a weld, the sequence of depositing the beads and their direction.

Satisfactory joints in armor plate can best be ensured by the use of downhand or gravity welding. Hence it becomes necessary to mount the jig on a mechanical manipulator (positioner) that can turn the whole assembly so as to bring each seam to an approximately horizontal position.

The new Humber armored car, Mark 4, has figured in many recent actions in Italy.

British Official Photo

This light reconnaissance car, the Morris Mark I, has a body shell of welded armor plate. It carries a Bren gun and an anti-tank gun; the Bren is fired through a manually operated, open-top revolving turret and can be used for anti-aircraft or ground strafing.

British Official Photo

Immunity: Theory and Practice

Firing trials soon showed that the welding process had very little effect on the immunity of the plate. In theory, "homo-hard" plate which after quenching is tempered at about 200 C (392 F), would be reduced in hardness by heating above this temperature, and a zone of reduced immunity would appear on either side of the weld. In practice, however, the metal nearest the weld gets heated well above the critical temperature and so rehardens itself by cooling in the air, while the temperature gradient in the rest of the plate is steep enough to insure that the zone of softening is too narrow to have a serious effect.

A ballistic junction weakness which may be anything up to 15% of the immunity of the plate, is experienced when the shot penetrates the plate near its edge. The edge is supported by comparatively soft weld metal and is bulged into the weld metal, thus permitting an easier penetration.

Thickness for thickness, the weld metal is certainly weaker ballistically than the plate. The butt weld, however, in plate up to 14 mm (almost 9/16 in.) thickness in which the weld reinforcement forms a considerable increase in the weld thickness compares very favorably with the parent plate, particularly at normal attack. At angle attack a slight ballistic weakness is to be expected.

Twenty-five/twenty weld metal is worse in this respect than 18/8, so the earliest practice was to finish off the weld with a few runs of very hard material from a special electrode of a different type. This was soon found to be productive of cracking and was abandoned in favor of the plan of building up the weld reinforcement to a greater thickness than the plate in order to compensate for its weakness. Hard-facing materials are effective only against angle attack; against normal attack they offer little or no advantage for the same reason that machinable quality thin plate is equal to "homo-hard" under normal attack.

Thicker Tank Armor

Although the armor of our wheeled armored fighting vehicles has remained fairly thin, that of our tanks has made enormous increases in thickness since the outbreak of war in order to keep pace with the increasing severity of attack by armor-piercing weapons. Initially, the thicker armor was made of the composition previously described, but lately the alloy content has been considerably reduced. To avoid cracking and flaking under the attack of the heavier projectiles, the hardness is essentially less than that used for thin plates designed to resist light attack. Hence the armor now used is machinable in its final heat-treated condition.

These changes have improved the position of welding for the following reasons:

(1) Machinable quality armor is far less likely to crack under welding than "homo-hard," and the greater thickness enables joints of greater mechanical strength to be made.

(2) The greater thickness of parent metal reduces the tendency of the weld heat to lower the ballistic properties adjacent to the joint.

(3) The ballistic strength of the joint itself becomes relatively less important, the major consideration now being that of resistance to shock.

Nazi Armor Harder

There is ample evidence to show that the Germans started welding their tank hulls and turrets long before the outbreak of this war. Generally speaking, German armor plate is of the chromium-molybdenum type, containing from 1 to 2.5% chromium and 0.3 to 0.6% molybdenum, with carbon varying between 0.3 to 0.5%. The carbon content is generally higher than that used in Britain, and this factor, taken in combination with the fairly extensive use of face-hardened armor, appears to have given the enemy considerable difficulty in effecting satisfactory welds. Battle behavior and fairly extensive trials have shown that under heavy attack the welds of German tanks readily split away from the parent metal.

It might be added that German armor of the homogeneous type is generally, thickness for thickness, considerably harder than that used on British tanks. While this provides a rather better resistance against calibre attack than does our own armor, it has the grave defect that when overmatched it cracks and breaks up.

America has gone over to welding on all current production, starting with the later makes of General Sherman medium tanks and General Stuart light tanks. The same applies to all American armored cars. The American welding is of the highest class and has given ample evidence of its mechanical ballistic soundness.

In Britain, the firing trials which have been carried out since 1941 against prototype heavy tank hulls and turrets and on numerous specially constructed targets have shown without doubt that heavy armor can be quite satisfactorily welded in this country and that, moreover, the joints which incorporate fillet welds ensure 100% immunity.

Compromise Construction

The first step towards the welding of heavy armor in actual production was taken with the design and construction of all-welded turrets for the Churchill tank, which were fitted as an alternative to the earlier cast ones. Welding was not introduced by the manufacturers of tank hulls owing to their fears of dislocating production by changing over to new methods. Although the loss of output would have been only temporary, the urgency of the demand for armored fighting vehicles was considered to make it undesirable.

A compromise form of construction was therefore employed. An inner skin of an easily weldable and ballistically inferior alloy—usually low-carbon manganese steel of the Admiralty "D" type—was bolted or welded together into the shape of the hull or the turret, and the thick armor plates were secured to it by high-tensile set-screws having large conical heads on the outside. The inner skin prevented flakes from flying off the back of the armor plate under heavy attack and wounding the crew.

Since the pressure on tank production has now become somewhat easier, it is possible to consider a changeover to all-welded construction. Improvements in armor quality have greatly reduced the risk of flaking and so removed any justification for the use of

an inner skin. It can, therefore, be safely assumed that all future British tanks will be designed and built with single-skin armor plates and castings welded together without rivets, bolts or supporting structures.

Today's Armor Weldable

Armor for A.F.V.'s is made today to the following specifications:

(*a*) Homo-hard. Now only used for certain thin-skinned wheeled vehicles in which weight considerations are predominant.

(*b*) Machinable quality. Used for plates of all thickness.

(*c*) Cast armor. Used for making turrets and sections of hulls as well as certain special fittings.

"Homo-hard" armor is still being made to the original 3½% nickel, chromium-molybdenum steel composition. Otherwise, our armor is now being made to different analyses which do not require so much of the scarce alloying metals. All of the armor steels are weldable with approved austenitic rods, provided that the carbon content is kept down to 0.35%. Even steels with higher carbon content may be welded satisfactorily if adequate preheating is used. Compositions with lower carbon can be welded with ferritic rods; this is a new development which will further ease the alloy position.

Certain types of carbon-manganese steel not strictly classifiable as armor (but having better ballistic characteristics than mild steel) have been used for inner skins of hulls and turrets and also for belly plates. These are based on the Admiralty "D" and "D.W." steels, and two types are used. The present tank specification calls for a 1.5% manganese steel, either heat treated to give a hardness figure of approximately 280 Brinell or left in the "as rolled" condition with a hardness of about 180 Brinell, according to the use to which it is to be put. The manganese steels are weldable with electrodes conforming to B.S.S.639 (1935) Class A provided that the carbon in the plates does not exceed 0.26%.

Types of Joints

Plates up to 15 to 20 mm (19/32 to 25/32 in.) are usually butt welded together with ordinary single-vee preparation. The electrodes used are large enough to ensure that there need only be two passes in the vee and a sealer pass on the back. Vee angles of 60 to 70 deg are preferred, but these figures can be exceeded. In an armored hull or turret, the natural angle between two adjacent plates is often such as to enable their edges to be left square; if the vee angle needs adjusting, it is usually possible to put the bevel on one plate only.

Fillet welds are preferred for thicker plates or for jointing thin plates to thicker ones as in the case of roof plates to side plates. Double-vee full-section butt joints may give greater mechanical strength for resisting the impact of heavy attack, but fillet-welded joints are more economical in time and electrode consumption and permit a much wider tolerance in profiling and assembly. Fillet-welded structures have been proved, both on the trial ranges in this country and in the course of the North African battles, to be ballistically and mechanically sound.

Plate Preparation

Profiling on both square and bevel edges is done by machine gas cutting. The tolerances worked to are $\pm$ 1/32 in. for plates up to 14 mm (almost 9/16 in.) and $\pm$ 1/16 in. above this thickness. Various kinds of fuel gases can be used for cutting straight edges, but acetylene is essential to cut bevels. Bevel-edged plates can be cut out in one operation whenever suitable machinery is available; it is, in fact, possible to cut two or more bevels simultaneously on one edge of a thick plate by using a multitorch machine.

The hull to be welded is usually broken down into subassembles, which are built up on jigs and held in position by clamps. In the case of light plate work such as for armored cars, the clamps are loaded by spring, air or hydraulic pressure to a predetermined value which will hold them firm while enabling them to slip sideways under thermal strain. The jig is often mounted in trunnions.

Welding Procedure

The plates are first tack welded together at suitable spots (determined by experiment), and the passes are laid in the order which has been found to give the best results from the standpoint of freedom from cracking and distortion. The first pass is joined to the ends of the tack welds and must not be laid over the top of them.

When a subassembly has been completely welded on the outside, it is turned over and the sealer bead applied. If the jig does not allow access to the back, a second jig is clamped to the front to keep the assembly from distortion during the back-up process. The various subassemblies are next mounted together on a main assembly manipulator to form a more or less complete hull. This manipulator enables the remaining seams to be brought to a nearly horizontal position (the limit of tilt allowed by the specification is 15 deg).

Plates thicker than 30 mm (1 3/16 in.) have their edges preheated up to 100-150 C (212 to 302 F) before welding. It is important that the assembly shop should be maintained at a steady temperature in the region of 15 C (59 F) and kept free from drafts. Postheating to relieve stresses has been found unnecessary except in the case of thin structures made of homo-hard plate, which need to be soaked at 200 C (392 F) for some hours to ensure freedom from cracking.

A typical assembly shop should be able to turn out from eight to ten heavily armored hulls per week of 100 hours with three main assembly manipulators. A shop of this type

(Please turn to page 74)

British Official Photo

Churchill tanks of a Canadian Army Tank regiment ready to set off for a practice offensive.

Saved: Oxygen and Acetylene

There are a thousand ways to waste cutting gases in a shipyard, but even a myriad of leaks may be plugged by intelligent, persistent effort. This article tells how Calship employees coöperated to conserve vital gases.

By **DON LLEWELLYN**
Burning Engineer,
California Shipbuilding Corp.

BUILDING ships on a production schedule is similar in a way to the making of a suit of clothes or a dress. The steel is received from the mills in various-size plates, angles, beams and channels just as the woolens come to the tailor in bolts. The tailor lays out the different shapes required with a pattern for the cutters to follow; the steel plates, too, are laid out with wooden templates for flame-cutting into various shapes and sizes by either gas-cutting machines or hand-cutting torches. There is a detail here, however, that is not found in tailoring: some of the plates have to have 90 deg edges while others will be given bevels.

The tailor makes up a right sleeve and a left sleeve, right and left legs, backs, etc. The steel plates and structural shapes are likewise cut for right and left and marked "starboard" or "portside."

Preassembly and Subassembly

As the assembled suit or dress is sent to the finishing department for lining, buttons, etc., so the parts are either welded into small assemblies in the plate shop or go on the preassembly skids and are fabricated into sections (usually as large as the cranes can safely handle). These sections are then moved to the shipways where they take shape in the final assembly or erection of the hull.

Another Simile

Building a ship is also something like putting together a giant size jigsaw puzzle. The elements of the puzzle, however, have been shaped by flame-cutting instead of by the jig saw. No matter how you look at shipbuilding, you can't get away from considering flame-cutting. From the time the steel plates and structural shapes are brought in from the steel yard until the final launching ceremony is over, oxy-acetylene torches play an important and indispensable part in the construction of a ship.

The building of 336 Liberty ships in less than three years (see THE WELDING ENGINEER, September, page 40) required around 2,000 machine and hand cutters—approximately 5% of the peak personnel (43,000) at Calship. Most of these flame-cutting operators had to be taught to use their tools, and the teaching process was of necessity kept to the shortest possible period. As fast as we could teach our trainees to use their hands to make a good cut with a hand torch or a machine, they were needed and taken into some department. Hence most newcomers lacked knowledge of the fundamentals of flame-cutting, and it is little wonder that they were prone to be wasteful of critical oxygen and acetylene.

Now in a shipyard there are a thousand and one ways to waste cutting gases. To eliminate or even to reduce such waste requires an extensive employee educational program. It is the purpose of this article to show why and how we conducted such a "Conservation" program.

Faced Oxygen Shortage

This country was facing a serious shortage of oxygen as early as September and October, 1942. By November we at Calship were using over 12,000,000 cu ft of oxygen per month; this was more than the eleven western states combined had used in normal times. On December 1, 1942, the vendors warned us that it was not only impossible for them to supply us with any additional oxygen but that it might even be necessary to cut our allotment. Yet our ship production schedule was on the upward trend, and we were still six months from our peak, reached in May and June of 1943.

Our situation was by no means unique. Other yards were starting and would require oxygen in large quantities as they hit their stride. Oxygen producing and delivery equip-

Fig. 1—The large bulletin board was pressed into service to carry a message of conservation.

SAFE

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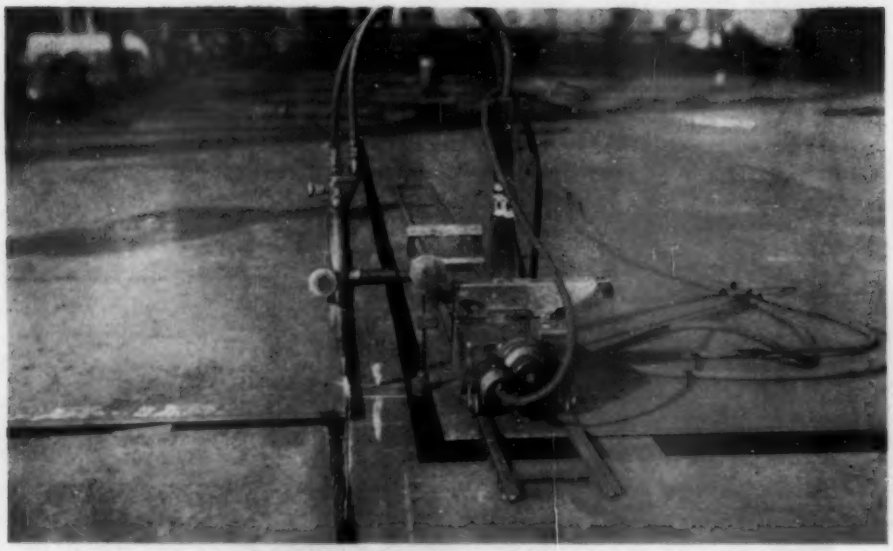


Fig. 2—The "roller burner" automatically cuts an edge exactly parallel to the edge of the plate to which the cut plate is to be welded.

ment the country over was taxed to the limit, but it was naturally our own problem that most concerned us. Something simply had to be done to tide us over until the nation's facilities for producing oxygen had been increased sufficiently to relieve the shortage.

Planning a Program

If we did not curtail waste, we would be forced to curtail our operations. Naturally, we chose the first alternative. A meeting was held on December 14th with vendors' representatives, our management, foremen of all production departments, our welding engineer, M. H. MacKusick, and the writer. The cards were laid on the table, face up. We were all told the seriousness of the situation. A representative of each department was then appointed and given the responsibility of eliminating the waste of oxygen and acetylene in his department. One "Conservation" instructor was appointed for each of the three shifts. The writer was given the responsibility of directing the program as a whole with, of course, the coöperation of all production departments.

Meetings were held on all shifts with the men appointed; a plan was worked out, and we worked diligently on this plan. Our large bulletin board (Fig. 1) was pressed into service. The Calship *LOG* ran articles on the conservation of critical materials; letters were written to the men and women appealing to them for their coöperation. And we got results!

In November, 1942, we had used 12,123,500 cu ft of oxygen to build 13 ships—922,644 cu ft of oxygen per ship. Six months later, in May, 1943, we used 12,615,000 cu ft of oxygen to build 19 ships (launched 20)—684,486 cu ft per ship. In other words, we built 19 ships in May with no more than 104% of the oxygen we had used to build 13 ships the previous November.

How We Did It

First of all, we had to depend greatly on our leadermen to conduct "on the job" training of their respective crews. The men appointed in the departments and our conservation instructors worked with the leadermen in an amenable manner to accomplish our purpose. There is only space here to list a few of the ways in which we reduced our waste:

We were working under "dim-out" regulations, and open wood fires were not permitted on cold nights. Hence we found stoves made of pipe or scrap and large preheating or cutting torches burning in them. Needless to say, the use of this expensive fuel for warming purposes was thoroughly discouraged.

A $\frac{1}{64}$ in. hole in a hose operating at 100 psi pressure will lose 290 cu ft of oxygen in 24 hours. Hence the hose repair department was called upon to check and test hose. Lengths were reduced to a minimum, and hose of the proper size was issued.

Tip sizes, pressures and speeds were corrected.

The pipe maintenance department checked seals, valves and connections for leaks.

Rigid regulations were issued against the use of oxygen for ventilating, blowing water and/or dirt from plates, blowing dust from clothing or from the weld seam, cooling hot gloves or feet, etc. These practices are not only wasteful but very dangerous. Blowing scale from the completed cuts with oxygen was also forbidden.

Allowing torches to burn while not in use, lining up cuts with the cutting oxygen stream, allowing other crafts to practice with the torches, using torches for hammers, mutilating tips, improper use of regulators, allowing cutting oxygen to run while starting a cut, cutting with the tip two or

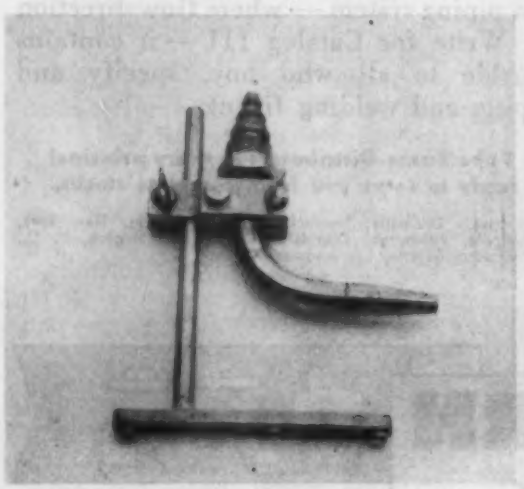


Fig. 3—The bulkhead trimmer is a torch support that may be set to a desired height. As the close-up shows, it is used with a tip bent 90 deg.

more inches from the plate (a smaller tip will make the same speed with 25% less gas when placed at the proper distance)—these and many other malpractices were reduced or eliminated by our training program through the coöperation of our leadermen and flame-cutting operators.

Our instructors also found and eliminated many cases of duplicated effort. Plates, for example, would be beveled to prepare them for welding, and these edges would later be retrimmed when the plates were fitted by another department.

Gas-Saving Gadgets

Hundreds of edges were difficult to cut and/or bevel in fitting, and to do it the hard way meant a cut-and-fit method that not only wasted man-hours but consumed cubic feet of vital gases. Various gadgets have been devised to simplify these plate-fitting jobs. In many cases, we found that one cut was all that we needed to produce the desired edge. These gadgets are usually devised by the men who compete in our Monthly Bond Contest on Suggestions. A number of them are pictured here.

Fig. 2 is a "roller burner" which makes a cut parallel with the plate it must fit for submerged-melt welding. This device eliminates one cut of the same length—a 50% gas saving. The attachment was designed here and is used on a portable motor-driven flame-cutting machine.

The "bulkhead trimmer" (Fig. 3) is a torch support that may be set to a desired height prior to cutting. It trims the bottom edge of bulkheads with one cut, supplanting the old cut-and-fit procedure. As the illustrations show, this device entails the use of a 90 deg bent tip in a hand torch.

The 30 deg bevel cutting attachment (Fig. 4) is also used on a hand-cutting torch. This little gadget, vest-pocket size, enables a manual operator to make cuts of high quality and maintain a constant bevel. Beginners find it easy to use.

In studying our Conservation Progress Chart, Fig. 5, you will note that from July through November, 1943, our production curve came down while our gas consumption went up. This is due to the fact that 30 of our 336 Liberties were tankers which were built during this time, and a tanker requires considerably more flame-cutting, fitting and shrinking than the standard Liberty. In December the production and consumption lines again crossed one another as the last of the tankers was delivered. We are now working on the new Victory, and this ship, too, will require more oxygen and acetylene as well as more man-hours to build.

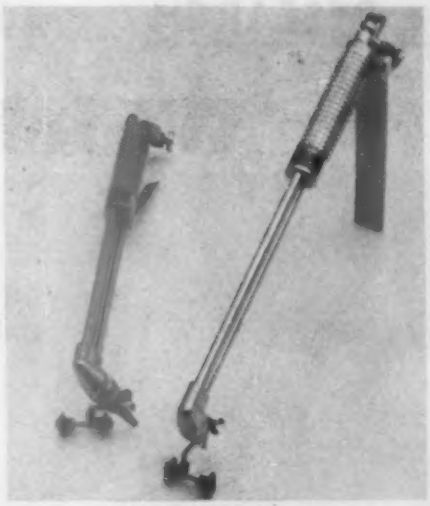
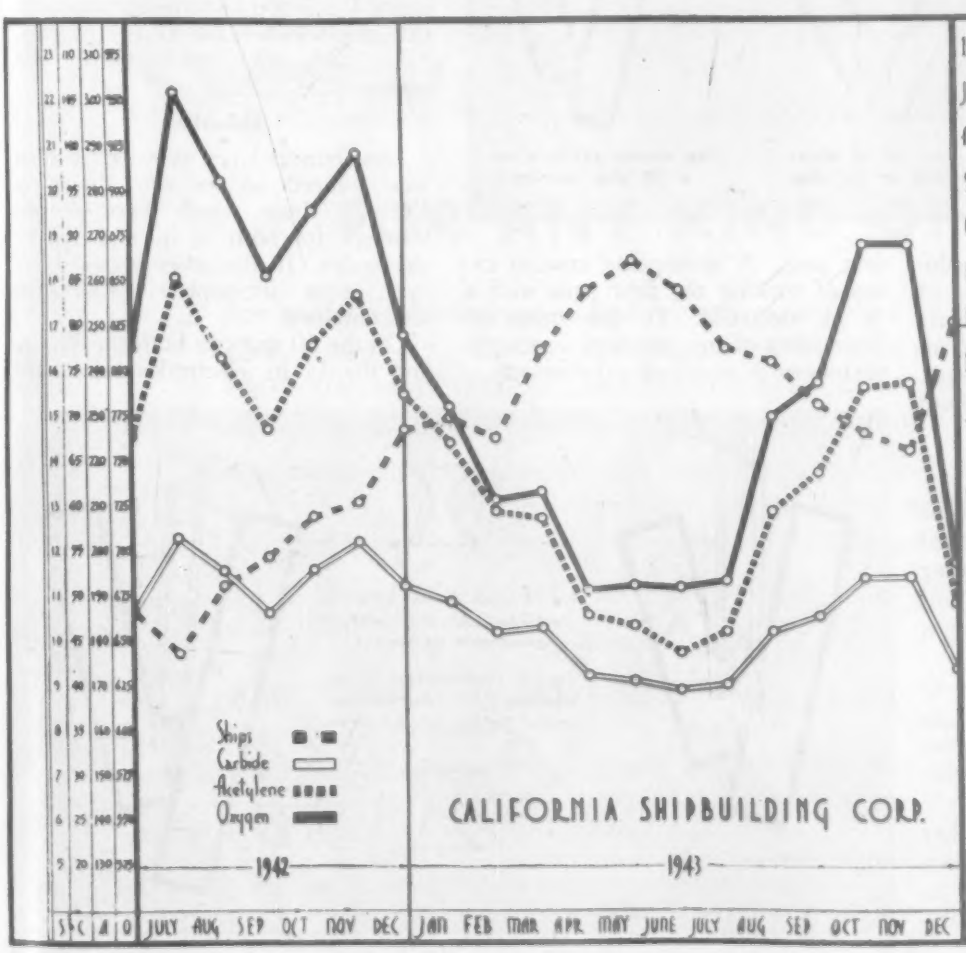


Fig. 4—This vest-pocket-size gadget enables a beginner to make perfect 30 deg bevel cuts.

Fig. 5—Conservation progress chart for carbide, acetylene and oxygen. The averages are based on equivalent ships. See text for the explanation of why gas consumption went up while the ship curve was sloping downward.



1942	SHIPS	CARBIDE	ACETYLENE	OXYGEN
JULY	9.8	56,837	261,688	956,751
AUG	11.30	53,097	243,613	907,757
SEP	11.94	48,911	227,861	853,973
OCT	12.82	53,432	246,605	891,100
NOV	13.14	56,545	257,660	922,644
DEC	14.74	51,066	235,291	821,265
1943				
JAN	15.02	49,567	224,628	782,037
FEB	14.58	46,159	209,319	729,938
MAR	16.41	46,557	207,992	734,100
APR	17.85	41,232	186,047	678,290
MAY	18.43	40,586	183,988	684,486
JUNE	17.83	39,652	179,755	680,803
JULY	16.65	40,248	182,572	684,604
AUG	16.25	46,092	209,043	775,248
SEP	15.26	47,903	217,692	793,273
OCT	14.63	52,016	236,473	870,360
NOV	14.25	52,070	237,489	869,193
DEC	17.18	41,851	188,323	692,592

Which Size for First Pass?

Where deep penetration is wanted on a tight butt weld, is it advisable to use a 1/8 in. or a 3/16 in. electrode on the first pass? The author experimented and learned that the conventional answer isn't necessarily right.

By JOSEPH S. WRIGHT

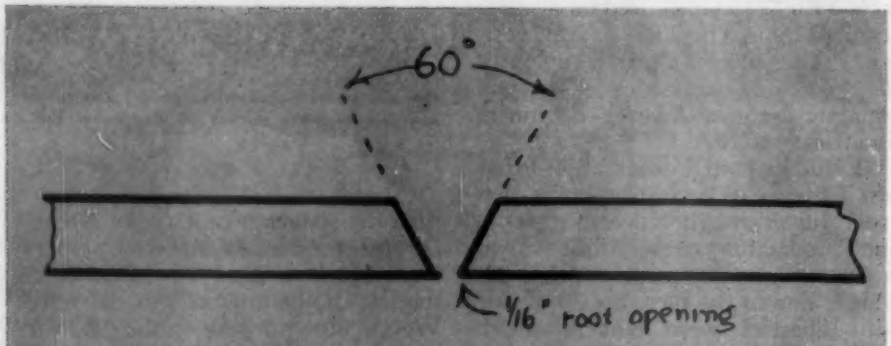


Fig. 1—In theory the ideal butt opening should be an angle of 60 deg plus a space at the root.

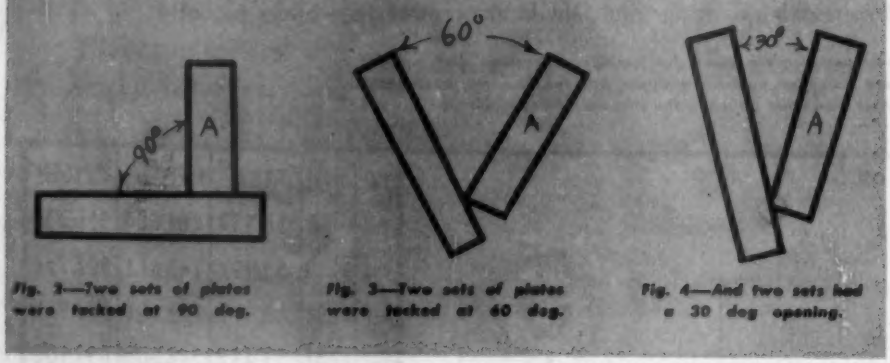


Fig. 2—Two sets of plates were tacked at 90 deg.

Fig. 3—Two sets of plates were tacked at 60 deg.

Fig. 4—And two sets had a 30 deg opening.

OFTEN encountered in ship construction is the question of whether to make the first pass in a tight butt with 1/8 in. or 3/16 in. electrodes. Let's examine this problem from the standpoints of both theory and practice.

Should Be vs. Is

In general theory two plates to be butt welded should be beveled so that there is at least a 60 deg opening (Fig. 1). In actual practice the butt opening is smaller, down to as narrow as 30 deg.

In general theory there should be a space at the root of the butt to facilitate penetration. In actual practice the plates are often fitted so tightly that there is no root opening.

When the plates are fitted together tightly and the bevel is 60 deg or less, the task facing the weldor is to get as deep penetration as possible in the first pass. A widespread custom exists of making the first pass with a 1/8 in. electrode. To determine the desirability of this practice, I recently performed a series of experiments.

The Experiment

Six sets of plates were prepared of 1/4 in. material. Two sets were tacked as in Fig. 2 with a 90 deg opening between them; two were tacked as in Fig. 3 with a 60 deg opening between them, and two were tacked as in Fig. 4 with a 30 deg opening between them.

One set of the above three plates was welded with 1/8 in. electrodes; the other set was welded with 3/16 in. electrodes. Reversed polarity, mild steel electrodes were used.

The welds were broken by bending the plates back and forth, and the plates marked "A" in the sketches were then examined to see how deeply the weld had penetrated. Where there was incomplete penetration, the distance between the corner of plate "A" and the weld metal was measured.

Results

One hundred per cent penetration was secured on the sets shown in Fig. 2 (those which were opened 90 deg) for both 1/8 in. and 3/16 in. electrodes. In the other plates, however, only incomplete penetration was obtained.

On the 60 deg sets both the 3/16 in. and the 1/8 in. electrodes penetrated

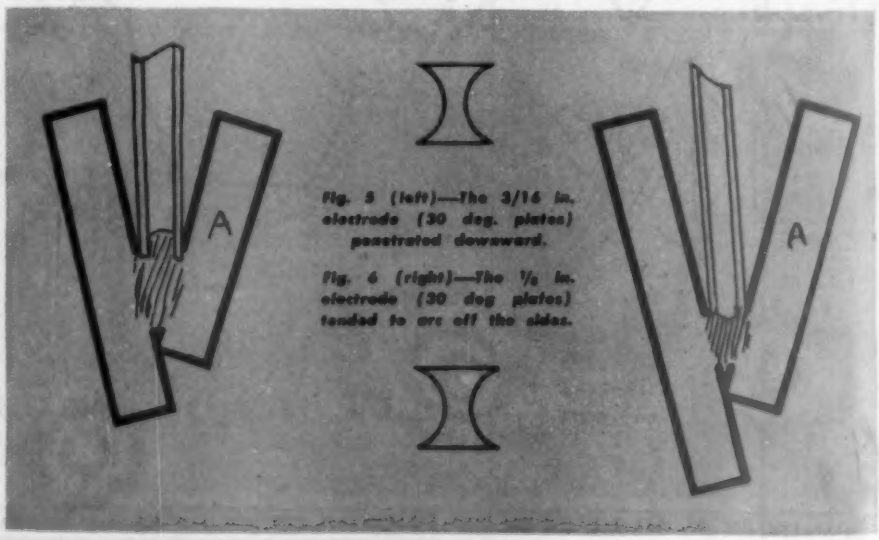


Fig. 5 (left)—The 3/16 in. electrode (30 deg. plates) penetrated downward.

Fig. 6 (right)—The 1/8 in. electrode (30 deg plates) tended to arc off the sides.

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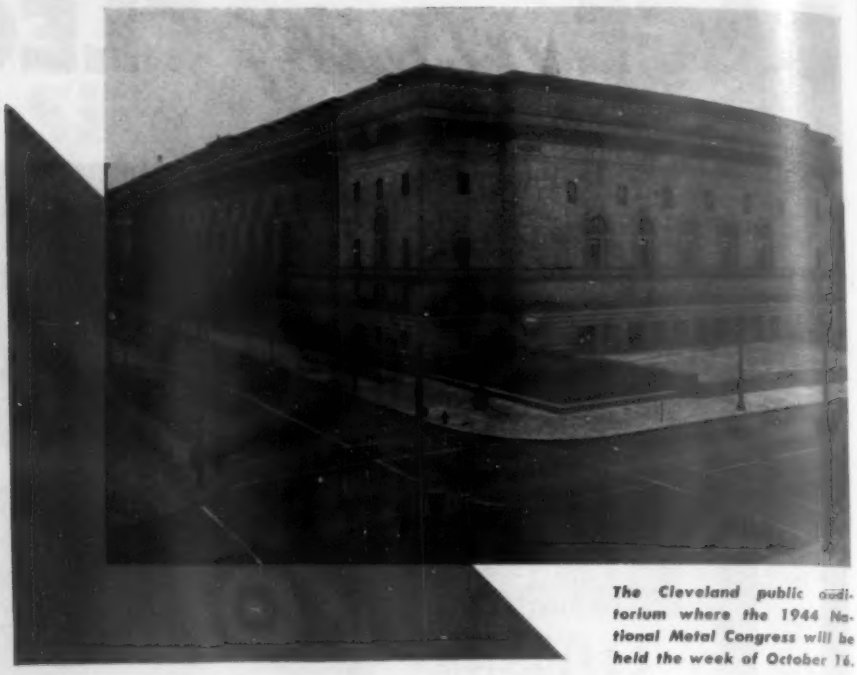

The Cleveland public auditorium where the 1944 National Metal Congress will be held the week of October 16.

National Metal Congress

One of the biggest and best of all metal shows is promised for the 1944 Congress and War Conference Display. There will be many new ideas and developments to aid postwar planning.

THE 26th annual National Metal Congress and War Conference Display, being held in the Cleveland public auditorium the week of October 16, will follow the trend of those of recent years. It will be largely an educational affair devoted to the study and future application of war developments in metals. Many of these ideas will be depicted by means of ingenious displays, working models and in some cases by actual demonstrations of the problems involved. Executives and engineering experts of the metal industry's leading manufacturers will explain and demonstrate developments in products, process and equipment and point out their applications in the design for tomorrow.

One of the Largest

The 1944 Metal Congress will be one of the largest in the 26-year history of this event. Nearly 200,000 square feet of exhibition space will be devoted to classrooms, lecture halls, conference and display spaces. There will be more than 300 conference displays.

The doors of the exposition will open at 12:00 noon on Monday, October 16, and will remain open every afternoon and evening until 10:30 p. m. with the single exception of Thursday evening. On that evening the exposition will close at 6 to allow the visitors to attend the various banquets of the societies that are holding concomitant technical sessions.

Panel Sessions

In conjunction with the congress, there will be held a series of meetings to summarize the new developments and processes of the war years and to take stock of the situation on the threshold of peace. Nearly 300 experts, representing the major branches of the metals industry, will discuss such problems in a series of practical panel-type sessions. These sessions will be held each afternoon and evening with the exception of Thursday and Friday evenings.

Working Demonstrations

Now that slackening war demands have freed material, many exhibitors will find it possible to have actual working demonstrations. Particularly will this apply to manufacturers in the welding field. Those bothered by tough welding problems may find it wise to bring samples so that they may obtain actual demonstrations as to the practicability of various materials and processes to their specific needs. Aid of this kind is one of the most valuable contributions that the Metal Show can make to those of our industry. It is a point that should be remembered.

Admittance to the exposition will be free to all members of the technical societies participating in the Congress and to those holding executive passes.

A Great University

Not for another year will there be such an opportunity to obtain information from outstanding authorities on the manufacture, production and fabrication of the metals—metals that are to be so important in our postwar planning. The congress may be likened to a great university with a faculty of thousands of production and technical wizards, all of whom are willing to put their store of specialized knowledge at the disposal of the sincere seeker for information.

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On the Job

Trucks over "the Hump"

NOTWITHSTANDING the many virtues of India's elephants—low gasoline consumption, slow depreciation, waterproof and weatherproof during the monsoon season—the U. S. Army prefers to use airplanes for delivering supplies from India to air bases in China. Not only food, gasoline, medical supplies and ammunition—even trucks are flown across the break in the Himalayas called the Hump.

How these trucks are chopped up into a mess of separate parts and packed for air transport is revealed by Fred B. Barton, war correspondent. The steel bed of the truck is neatly flame-cut in two, Barton reports. The G. I. with the cutting torch in India knows that another G. I. in China can weld the pieces back together again, as strong as they ever were. Ambulances get similar treatment. Once they have arrived in China, the ambulance parts are put together with bolts and nuts, and the cut sections are restored by welding.

A standard air-cargo item is the 2½ ton truck. "Into a C-47 with a known capacity," Barton writes, "the soldiers at the India air base crowd in a complete 2½ ton truck: first the front wheels followed by the rear axle including the differential, truck bed, truck body and incidental parts. Just one truck makes a terrific mess of loose parts when spread out on a truck-and-trailer and towed from the Ordnance Depot to Air Freight for loading."

The men stationed at this jumping-off place for China are not in exciting, story-book Delhi or Calcutta, but in the tea-growing section of Northern India with nothing but mud and tea-paddies around them. So far north is their air base that the fliers have to travel south as well as east in order to enter China.

» «

Valve Wheel Extensions

By Charles C. Lynde

A SERIES of valve wheels were found to either come flush with or project just above an expanded metal floor. Some method for simplifying manipulation of the gates being necessary, the plant weldor was called upon to provide extensions.

He began by cutting discs of diameter equal to the hand wheels from light sheet steel. A hole was drilled through the center of each disc to give clearance for the valve-retaining nut, and other holes were drilled near the edge to accommodate the U-bolts used to attach the disc to the wheel.

Around the space allowed for the valve stem nut was welded a short stub of large pipe. This tapered after 6 in. to a 1½ in. diam stem, which rose to a convenient operating height. A T-head was welded across the top of the stem to provide the leverage required for moving the gate. Finally, a pair of slots were cut through the enlarged section at the base to permit visual check on the position of the valve stem. By looking through these slots, one can tell at a glance whether the valve is open or closed.

» «

Electric Motor Repair

EVERY old electric motor that can be repaired and put back into service is equal to the contribution of a new motor to the war effort. But care must be taken when welding the broken electrical connections, or the welding heat may do more damage than good.

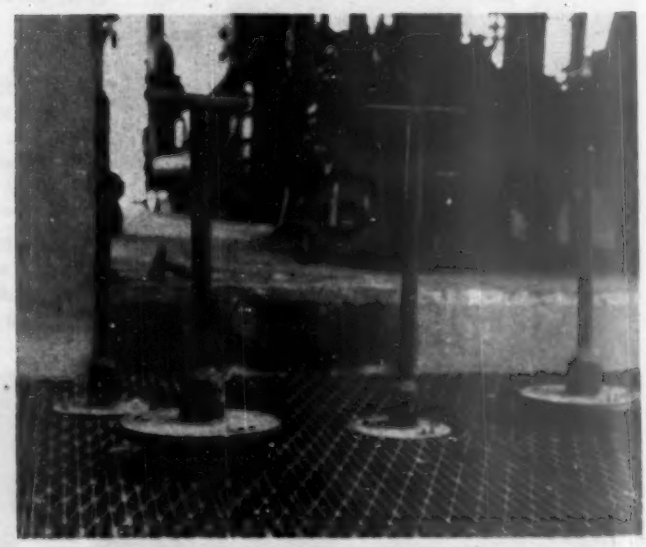
Loose connections between the copper end ring and copper rotor bars were cutting down the speed of a squirrel-cage motor. These joints are often soldered, but the repair man believed that better results could be secured by low-temperature welding. An alloy flowing freely on copper between 1,150 and 1,200 F and a temperature-indicating flux were used.

First, all traces of previously used solders and all grease and oxides were removed from the surface of the metal in the weld area. The joint was then painted with flux. Two torches, each adjusted to a slightly excess acetylene flame, were employed to bring the heavy laminated copper end ring up to the proper temperature before the heat could run down the rotor bars and warp the steel laminations. The melting of the flux indicated when the proper temperature had been reached to apply the brazing alloy.

When reassembled, the motor ran up to its rated speed.

Truck being reassembled. This vehicle was driven from a dock to an airport in India, broken down with the aid of the cutting torch, loaded into a C-47 cargo plane and flown across the Himalayas to "somewhere in China."

Courtesy, The Lincoln Electric Co.



The rising stem of each of these gates is accommodated within (and thoroughly protected by) the extension stem. Note that the extensions are supported on wide discs instead of being held, as usual, by flanges under the valve wheel nuts.

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To make knives by this procedure, a blank blade is cut from steel boiler plate, and the outer circular edge is rabbeted on a milling machine to provide a recess with a depth of slightly more than half the knife's thickness. A cobalt-chromium-tungsten hard-facing alloy is then applied to the recessed area. This layer is covered with a thin layer of steel by oxy-acetylene welding, and the steel is built up by the metal-arc process to fill the remainder of the recess. The edge is sharpened by grinding 15 deg bevels on both sides, and the knife surface is ground flat.

When completed, the knife is self-sharpening, since it sharpens itself evenly as both sides wear. If desired, the hard-facing alloy can be extended to a greater depth within the blade at the points of greatest wear, thereby compensating for non-uniform wear of the blade along its length.

This sugar-cane mill knife is having its cutting life greatly lengthened by what amounts to an inserted core of hard, wear-resistant alloy.

Courtesy, Haynes Stellite Co.

» «

Gear Blank in Halves

BECAUSE of installation difficulties, The Aldrich Pump Co. of Allentown, Pa., required a 1,560 lb welded steel gear blank fabricated in halves for assembly by welding.

The blank was constructed by Lukenweld, Inc., a division of Lukens Steel Co. It has a rim of gear rim steel 4 ft 5¾ in. OD by 1½ in. thick, with an 8½ in. face. The bore is 4⅝ in. in diameter by 10½ in. long. The web plate is ¾ in. thick with ½ in. stiffening ribs.

The pump company has used quite a number of welded steel gears, and they have all been satisfactory. Many of these gears have been driving sump pumps in mines 24 hours a day, 7 days a week, for years.

A 1,560 lb welded steel gear blank that had to be constructed in halves.

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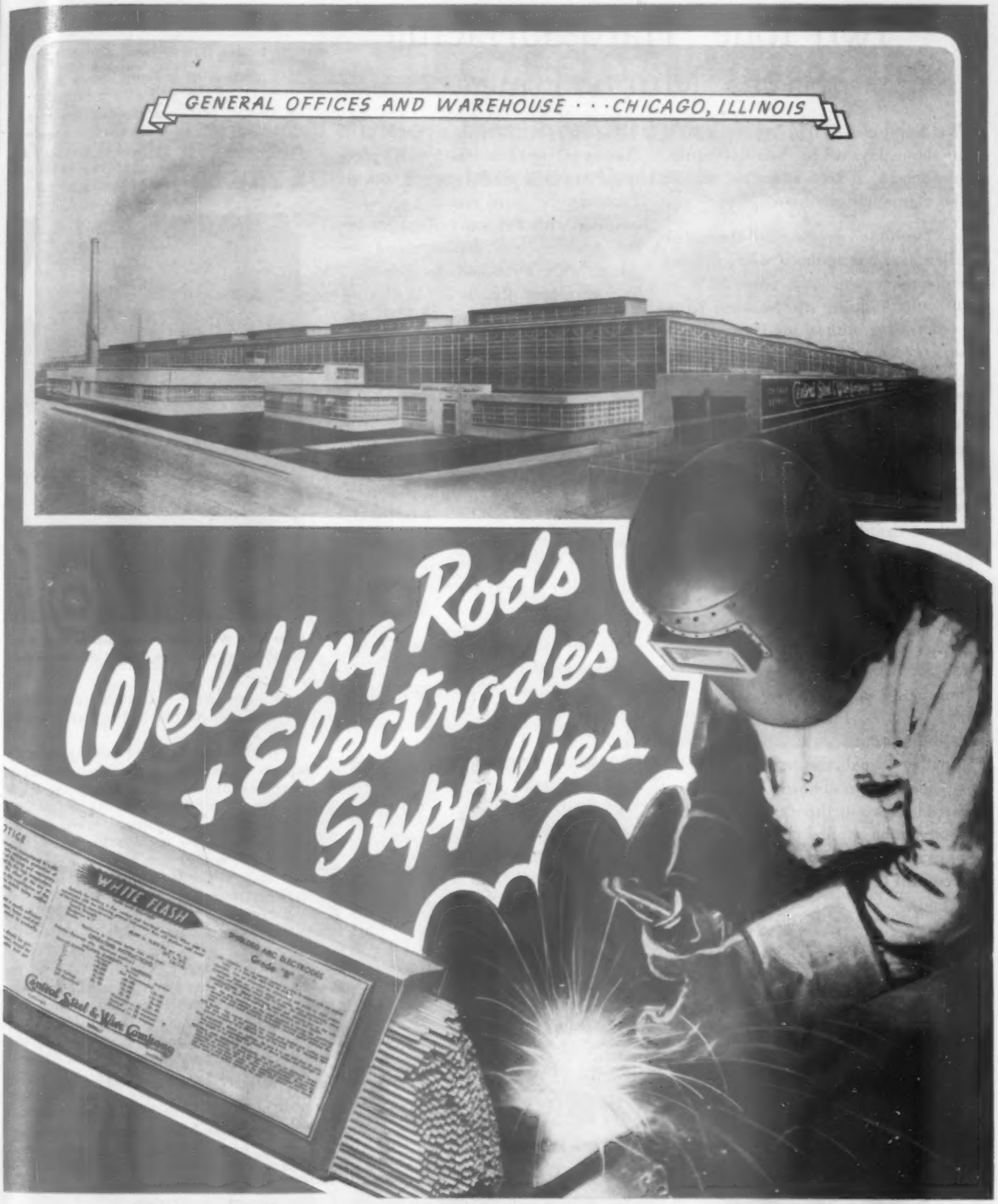

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"Two-Tone" Hard-Surfacing Saves Much Time

Welding time is highly valuable time in these days when essential equipment must be kept operative despite the manpower shortage.

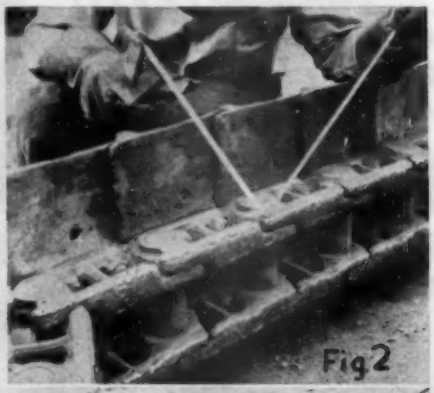
"Two-tone" welding and the use of filler bars has reduced working time on conservation jobs from 30% to 50%. In building up the worn parts of a tractor with a total area of 41 square feet, ordinary welding methods would require 70 to 100 hours. With "two-tone" welding and the use of Amsco filler bars, working time is kept well within a 48-hour limit.

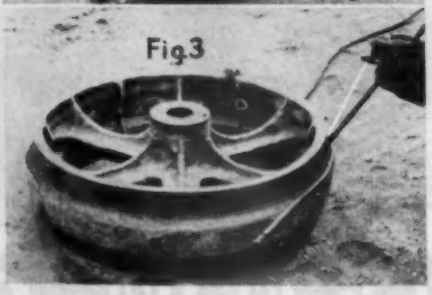
Fig. 2 shows the "two-tone" process of rebuilding a worn track rail, with a mild steel reverse-polarity type electrode in the electrode holder, while the operator holds an Amsco Economy Hardface rod adjacent to the arc. Equal quantities of the mild steel electrode and the hard-facing rod are consumed, mixing together thoroughly and giving a deposit of high wear-resisting properties, As the welding progresses much more rapidly than usual, the parent metal is not subjected to abnormal heating or warping. Two or three times as much metal can be applied per hour as with conventional methods. It is very easy to control the deposit even on narrow sections.

Fig. 1 is a photomicrograph of a "two-tone" weld in which a ¼" electrode was used in conjunction with an Economy ⅜" bare rod. "Two-tone" welding with Economy Hardface as the auxiliary rod makes sound deposits with a Brinell hardness of approximately 450, is air-hardening and provides a surface that resists impact as well as abrasion. The tensile strength of the deposit photographed is estimated to be 150,000 lbs. per sq. in.

Fig. 3 shows "two-tone" welding being applied to a worn tractor idler. Amsco's Economy Hardface is dark colored rod in welder's left hand; mild steel rod, light colored, in electrode holder held in welder's right hand. Filler bar is partially tacked in place.

Ask for Bulletin 941-W on Amsco Welding Products, all of which have been developed for conservation welding.





Amsco
AMERICAN MANGANESE STEEL DIVISION
Chicago Heights, Illinois
FOUNDRIES AT CHICAGO HEIGHTS, ILL.; NEW CASTLE, DEL.; DENVER, COLO.; OAKLAND, CALIF.; LOS ANGELES, CALIF.; ST. LOUIS, MO.
OFFICES IN PRINCIPAL CITIES
AMERICAN Brake Shoe COMPANY

Big Brazing Job

By Norman E. Smith,

Welding Engineer, Smith & Longnecker, Joliet, Ill.

A 35 ton, cast-iron crusher spider being used by a midwestern company to produce limestone cracked in several places, causing an immediate shutdown in the midst of a large Government contract. Replacement being impossible under six months, the decision was reached to repair the big spider by brazing.

Over 300 lb of manganese-bronze rod were deposited to repair this 35 ton crusher spider.

The main crack started halfway along the bottom, extended up the side and about three fourths of the way across the top of the leg. Several smaller cracks, ranging from 8 to 29 in. in length, were in close proximity, so we decided to cut out the entire area and fit in a piece of steel. This was quite a job as the casting varied in thickness from 4½ to 8 in.

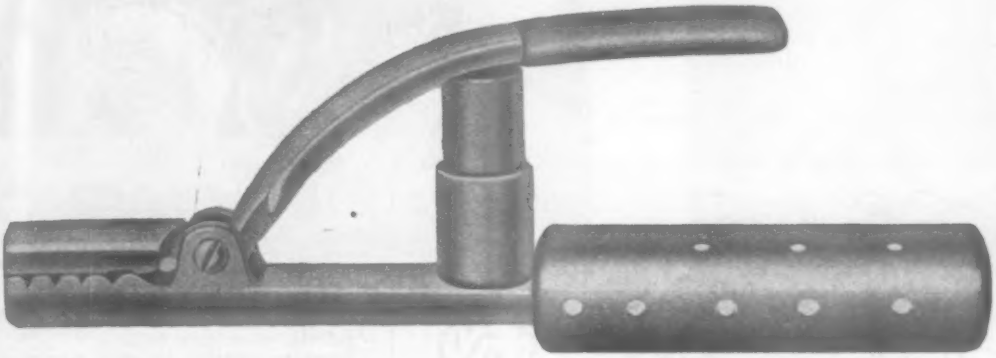
Three men worked two 24-hour shifts drilling, chipping and aligning the casting for welding. The spider was positioned so that all of the welds could be made in the vertical and horizontal planes; this also saved us considerable preheating time as it was necessary to build and maintain only one preheating fire. The preheating fuel was charcoal, and we used ¾ of a ton of it. After the casting had been heated to a good black heat, three weldors went to work on it, spelling each other at half-hour intervals.

We completed the job in 27 hours, depositing some 318 lb of ¼ in. manganese-bronze welding rods and using up 8 lb of brazing flux, 2,640 cu ft of oxygen and a like amount of acetylene.

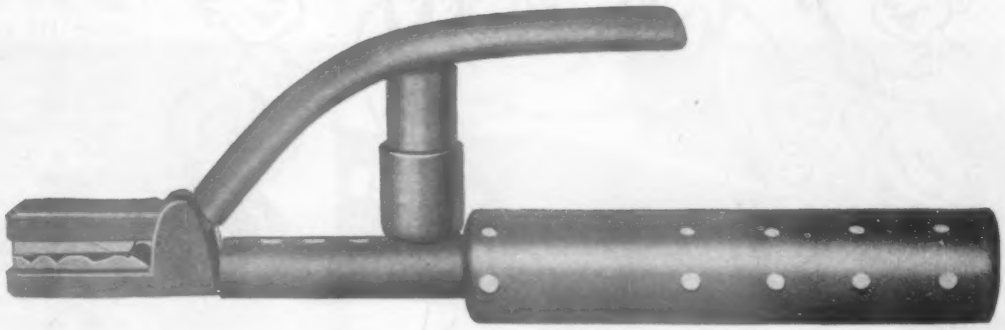
The casting was completely covered with asbestos paper in order to retard the rate of cooling; four rolls of ⅛ in. asbestos paper were needed for this purpose. The cooling period was held to 16 hr, after which the repair crew was permitted to reassemble the crusher unit. The unit was back on the job in less than five days, and it has crushed some several hundred thousand tons of limestone since we effected the brazed repair.

THERM-ARC ELECTRODE HOLDERS

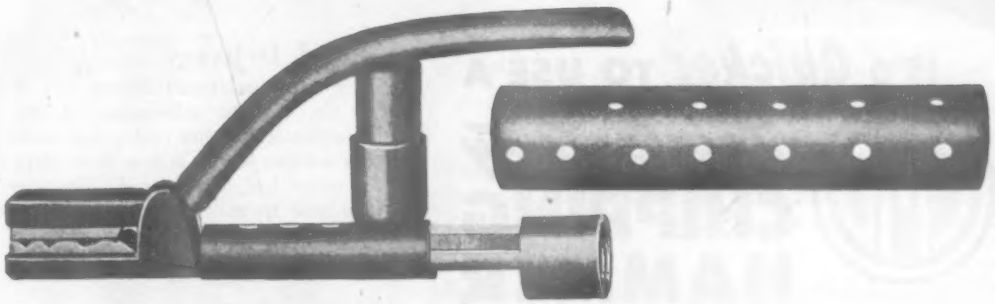
A Type of Holder that has Proven Itself
The only fully-insulated coil spring holder



TYPE N
Partially Insulated



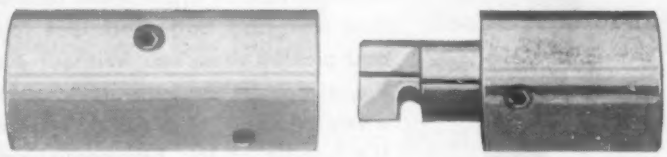
TYPE K
Completely Insulated



TYPE M
Detachable Completely Insulated With Removable Front

THERM-ARC CABLE CONNECTOR

This unit can be connected or disconnected quickly by a very short turn. The action is instantaneous and a tight, contacting connection is assured throughout entire circumference of male plug; no possibility of loosening while in use.



Write for our attractive, illustrated, descriptive booklet of THERMEX Holders and Cable Connectors.

THERMEX EQUIPMENT COMPANY

2045 Celia St. **Tel. TYler 7-1337**

DETROIT 8, MICH.

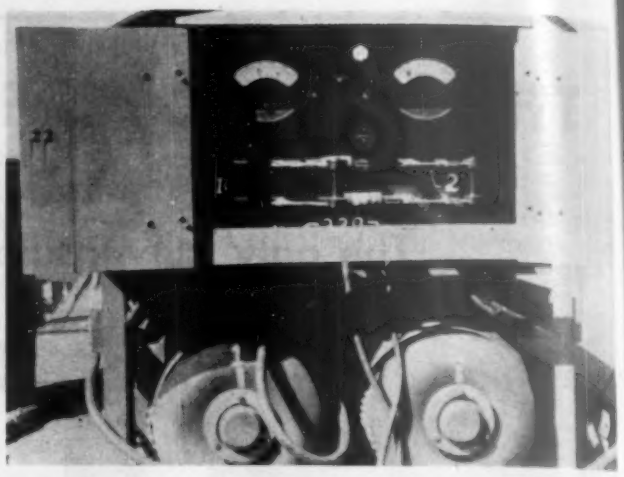
Generators from Welders

By Harry Baylie,

Chief Electrician, J. H. Mathis Shipbuilding Corp.

A RECENT contract for Army cargo boats required the use of a power generator for test purposes and to supply the ships with auxiliary power at the fitting-out dock. Unable to obtain a motor-generator set within six months, we decided to do a little experimenting with our welding equipment.

These boats require 230 volts d-c three-wire service for power and light. We should have had a 40 kw generator since the largest piece of equipment to be tested was 50 hp. We found that our 300 amp arc welders, which were connected for constant potential, could be made to put out 115 volts by substituting an additional shunt winding in place of a part of the series field coils and by making the extra shunt coils self-exciting. By connecting two of these machines in series, we obtained the needed 230 volts.



Two 300 amp arc welders made a handy portable generator for testing the light and power facilities of Army cargo boats.

Courtesy, The Hobart Brothers Co.

Separate switches on each generator enable us to use the outfits for supplying either 115 or 230 volts. Although their combined output should really be no more than 30 kw, we have had no trouble with the machines when running them at considerable overload for limited periods.

All of our power facilities on the piers and ways terminate in power panels with fused receptacles, and this makes it convenient to shift the individual machines from boat to boat. We have made up two power units, which are readily removable to any point at a moment's notice. This work was done at a $1,000 saving to us.

» «

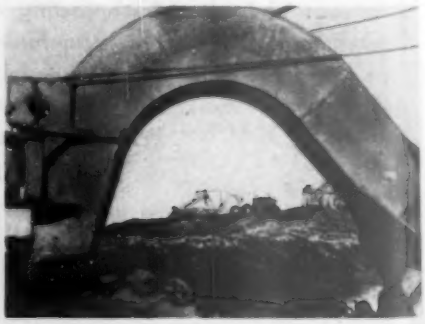
Rapid Delivery

AN ORDER to the Babcock and Wilcox Co. for the fabrication of 5½ tons of carbon-steel boiler tubing was on its way to a waiting vessel within three days after the order had been placed. The ship was thus able to sail on schedule, avoiding a delay in the transportation of vital war supplies.

» «

To Move the Earth

THE yoke of a giant earthmover frames others of its kind at work leveling hills in Iceland in the dramatic picture below. Arc-welded construction is standard on these big machines.



Official Signal Corps Photo. Courtesy Lincoln Electric Co.

IT'S *Quicker* TO USE A

CMD *Triple-Duty* CHIPPING HAMMER

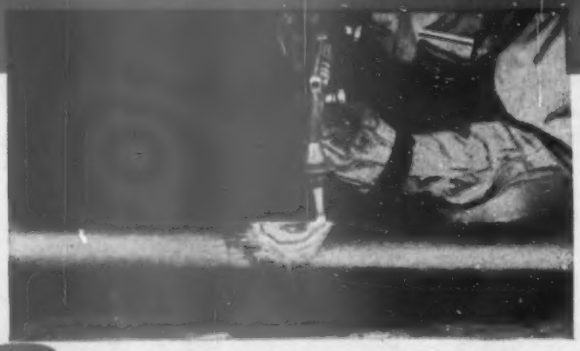
Triple Duty TYPE CB
3 tools in one. Brush replaceable when worn. Well balanced. Weight 1 lb.

With the Type CB combination drift and chisel hammer, a welder can greatly speed up his output. For he can spend more time welding and less time removing slag—less time laying down tools and picking them up. Without even setting aside the electrode, he can start immediately to chip away the slag. The handy replaceable brush on the handle of this hammer is instantly available when he needs it. For details and prices on this and other popular CMD welders' Chipping Hammers, ask your jobber for latest circular or write direct.

CHICAGO MANUFACTURING AND DISTRIBUTING COMPANY
1928 WEST 46th ST., DEPT. W., CHICAGO 9, ILLINOIS

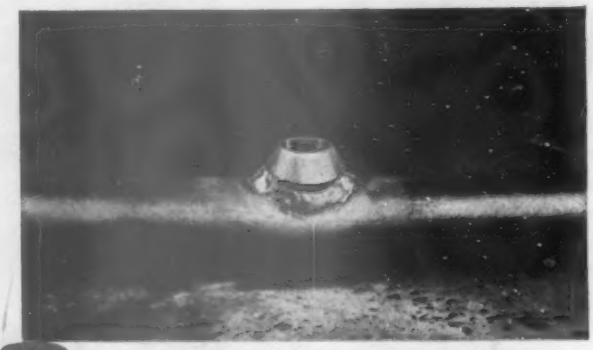
How to Make a Branch Outlet in 4 SIMPLE STEPS

1 Position WeldOlet on main pipe by center line marking on fitting. Mark off hole with scriber and center punch.



2 Flame cut hole in main pipe by following center punch marks. Hold cutting torch nozzle perpendicular to pipe while cutting.

3 Position WeldOlet on pipe again and tack weld in place. Tack fitting with 1/8" separation from main pipe.



4 Fitting welded solidly in place with full strength of main pipe restored. Neat in appearance and easy to inspect inside.

WeldOlets provide the easy, economical method of branch pipe outlet installation for size-to-size or reducing sizes. They can be installed in the shop, on the job or to existing pipe installations.

Must original pipe strength be maintained? Must flow friction be held to a minimum? Is it a hard-to-get-at installation? If so, try WeldOlets next time. You will be pleased with the result.

WeldOlets are available in three types—with welding outlet, threaded outlet, and socket outlet. For details on the WeldOlet method write for Catalog.

Forged Fittings Division · BONNEY FORGE & TOOL WORKS · *354 Green St., Allentown, Pa.*

WELDOLETS
TRADE MARK REG. U. S. PAT. OFF. PAT. IN U. S. & FOREIGN COUNTRIES
WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET
For Welded Branch Pipe Outlets

Arc Welding Armor Plate

(Continued from page 55)

would have to be manned by about 12 fitters and 30 welding operators and equipped with twenty-two 300 amp welders and eight 600 amp welders, the latter being used for the thick vertical armor.

The weight of electrode metal required for a hull varies according to type, but the heavier types of modern tank would require something of the order of 500 lb of austenitic electrodes in the hull alone.

Mild steel fittings can be secured to the interior of hulls or turrets either by welding them direct or by bolting them onto studs welded on the armor. The adhesion of such fittings is a matter of vital importance. Any which become detached under the impact of a heavy projectile will fly across the hull with great violence and may cause fatal casualties. It is, therefore, stipulated that all such fittings must be welded on with approved austenitic rods of the type used for welding armor, and this applies equally in the case of inner skins made of the carbon-manganese types of plate. When studs are used they may be fixed by an automatic stud welding gun or by a projection resistance welder.

The same provision applies to external mild steel fittings which are subjected to load. Non-stressed external fittings, however, may be welded on with suitable ferritic electrodes.

It may be mentioned here that in the Middle East fittings of all kinds were welded on to both the inside and outside of hulls and turrets with ferritic electrodes, which were quite plentiful. Austenitic electrodes were extremely scarce and reserved for joining armor to armor.

Field Repairs

Arc welding has proved of the greatest value in repairing battle damage in field workshops by patching up holes with pieces of plate or else filling them in with weld metal. Holes in rolled plates are usually flame-cut to a clean outline and covered with a suitably overlapping patch of the same thickness. A fillet weld is run round the outside of the patch and another one round the inside of the hole.

This process, when carried out on the vertical side wall of a tank, calls for an amount of both vertical and overhead welding.

Holes and scoops in cast armor are filled by weld deposit. Electrodes can be saved by welding in odd pieces of armor steel, high tensile bolts and pieces of armor-piercing projectiles, like "plums" of rock in mass concrete. This is usually done with austenitic electrodes, but it has also been found possible to repair armor castings with a mild steel electrode containing molybdenum.

Some very good repair work of this kind was done on Grant and Sherman tanks in the Middle East, both in base and in field workshops; the welders, who were nearly all R.E.M.E. personnel, attained considerable skill, and the external finish of the welds had the appearance of a beautifully darned sock.

Dangerous Weld

We saw one case of a Crusader which had a German 50 mm armor-piercing shell lodged halfway through one of its front plates; the workshops officer told us that he proposed to weld it in position. Had it been one of our solid shot, such as the 6 lb anti-tank projectile, this would have been a good idea. Being a German projectile, however, it was provided with a bursting charge, which had for some reason failed to go off. We explained this, and recommended a more delicate approach.

Stand the Gaff
Radiant
SPATTERPROOF LAMPS
Radiant Spatterproof Lamps are designed to withstand severe welding service. They are built of special glass that resists rough handling and penetration of hot metal spatter. Radiant Spatterproof Lamps are more economical and increase production by reducing lamp replacement to a minimum. Send us a trial order today.
RADIANT LAMP CORPORATION
Lamps from 50 to 10,000 watts
300 Jelliff Avenue Newark 8, N. J.
PROOF
Lower lamp still burns despite severe service.

USE THIS FREE-FLOWING ALLOY IN ANY TYPE OF BRAZING

To Eliminate Extra Operations

A portable unit is used here to braze armature leads with tops of commutator riser. In a similar application, one electrical manufacturer saved 3,750 pounds of critically scarce tin on one motor contract by switching from soldering to Phos-Copper brazing . . . and cut costs by more than 75%!

Phos-Copper brazing eliminates extra machining and finishing operations with any type of brazing . . . gas, incandescent carbon, dip, induction heating, or electric furnace . . . for any kind of joint, either butt, scarf, lap or shear.

No flux is needed on most copper brazing, and complicated jigs and fixtures are unnecessary. Very little Phos-Copper is needed to produce a strong, uniform joint, and its low free-flowing temperature (1382° F.) speeds assembly operations.

Nearly every phase of manufacturing, installation or maintenance work can use Phos-Copper at lower cost with better, faster results than expensive silver solders or high-temperature alloys.

Joints of high electrical conductivity are produced with Phos-Copper, and corrosion resistance, uniformity and excellent penetration contribute to its many advantages. Tests have shown Phos-Copper to have greater strength and vibration resistance than 20% silver solder.

Phos-Copper is available now in rod, ribbon and special shapes for immediate delivery. Get complete information on Phos-Copper from your nearest Westinghouse office. Or write Westinghouse Electric & Manufacturing Company, P. O. Box 868, Pittsburgh 30, Pa.

J-90544

Brazing generator stator with Phos-Copper, using incandescent carbon method. So little Phos-Copper is needed to produce a strong, uniform joint that extra machining and finishing operations are not necessary.

Westinghouse

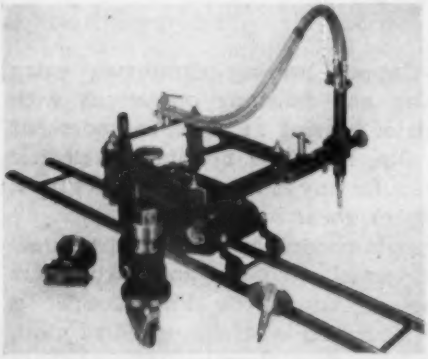
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Phos-Copper

New Products to Use

Cutting-Machine Attachments

★ Several newly designed attachments greatly enhance the usefulness of the "Gaso V-10" flame-cutting machine. To this portable motor-driven cutting machine there has been added a tracing head, a circle-cutting radius rod and a spindle head attachment. The tracing head permits irregular shapes to be flame-cut by guiding the tracing wheel over a drawing (full-size), blueprint or sketch. One or more torches mounted on the other end of the attachment will duplicate the path of the wheel.



"Gaso V-10" cutting machine with tracing head mounted for operation. The template head is shown on the left and the spindle head at right.

The circle-cutting attachment may be joined to the tracing head assembly to cut out circles from 2 to 16 in. in diameter. The radius rod is scale marked in inches to speed the set-up time. Both tracing head and circle-cutting attachment are furnished as standard equipment with the machine.

The spindle head is an optional attachment that replaces the tracing head when it is desired to speed up the production of small quantities of duplicate shapes. This unit is kept in contact with the outline of a wood pattern.

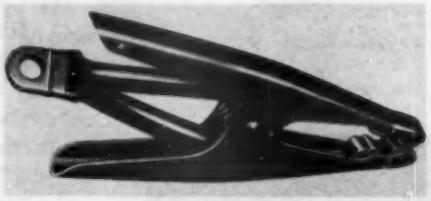
Where large quantities of duplicate parts are to be flame-cut, a template head is used. This consists of two parallel steel rollers that rotate horizontally. These wheels contact a metal bar track between them and so automatically follow the track contour.

The Gaso V-10 machine is equipped with a variable speed motor and a positive speed adjustment. It will travel in either forward or reverse direction and has a speed range of from 4 to 60 in. per minute. A 4 ft track is provided for straight-line cutting. The torch holder can be adjusted to any angle, and as many as four torches can be mounted if desired. **Gaso Equipment Co.**, 3253 North Kedzie Ave., Chicago 18.

» «

Ground Clamp

★ A new low-priced ground clamp for weldors has been announced by **The Lincoln Electric Co.**, Cleveland. This clamp is so designed that each jaw connects independently to the ground cable; thus if one jaw is prevented from making a good electrical contact the other jaw will carry the current. Having a heavy-duty processed steel frame with copper conductors and contacts, the unit weighs 1½ lb, has a maximum jaw spread of 2½ in. and a rating of 300 amp.



New Lincoln ground clamp. It features dual-jaw connection for carrying current.

» «

Steel and Stainless Flux

★ A newly developed welding flux suitable for use in mild steel and stainless steel rods (a-c or d-c) is called to the attention of manufacturers of coated welding electrodes. This flux, "Weldalene," begins to sinter at about 1,920 F, but it does not deform below approximately 2,140 F. Consequently, it is an active flux over a wide range of temperatures. Its ratio of alumina to silica is 24 to 60%, indicating that it may reduce the silica included in weld metal. It contains a substantial percentage of potassium, an element contributing to arc stabilization. Finally, it is said to be an excellent vitrifying agent. **Foote Mineral Co.**, 1612 Summer St., Philadelphia.

» «

Jackson Holder

★ A tong-type, fully insulated electrode holder of unusual lightness has just been announced by **Jackson Products**, 3265 Wight St., Detroit 7. Model A-4 takes electrodes to ¼ in. and Model A-5 to ⅜ in. Both models are said to show a 40% weight reduction over other tong-type holders of the same capacity.

Additional features are: tongs of tough, lightweight alloy; easily replaceable copper jaws; patented crown-type insulators; metal-clad jaw insulators; new pivot hinge providing a quick method of knock-down and assembly; free-flowing ventilation; mechanical cable connection.

Metal-clad jaw insulators, replaceable copper jaws and a 40% weight reduction feature Jackson's A-4 and A-5 holders.

Inspection Film

★ "Faxfilm" is a new product that permits the enlarged three-dimensional projection of a contact impression of any surface. It thus provides: (1) comparison with specified standards, (2) immediate surface inspection and (3) a permanent record if desired.

Section of a machine-finished steel bar (finished to 250 RMS) as reproduced on "Faxfilm" and enlarged in a projector. Magnification, 100 X.

The process (non-photographic) is simple. The use of a solvent softens one surface of a plastic film enough to permit the making of a contact replica in three dimensions of the surface. The small piece of film is then mounted in a cardboard frame which fits any standard projector. It can thus be enlarged 100 diameters or more and will show all of the surface contours in three dimensions. The Faxfilm kit contains 250 frames, a bottle of solvent, a roll of plastic film, a moistener, etc. **Rex D. McDill**, 5109 Mayfield Road, Cleveland 21.

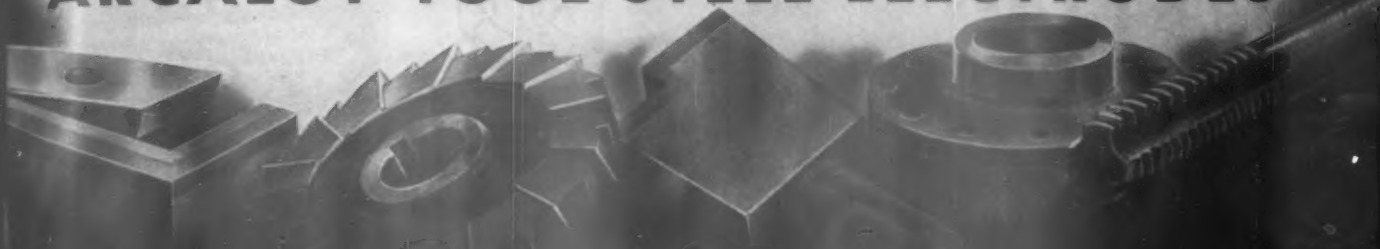
» «

Heavy-Duty Vise

★ The Jenkins "Bar-Lok" is a fast locking, heavy-duty vise that is set and released by means of a push-pull pressure unit. The latter has a positive locking contact at four points and will develop pressure up to 20,000 lb. Only a quarter turn of the handle locks or releases. **Mechanics Engineering Co.**, Jackson, Mich.

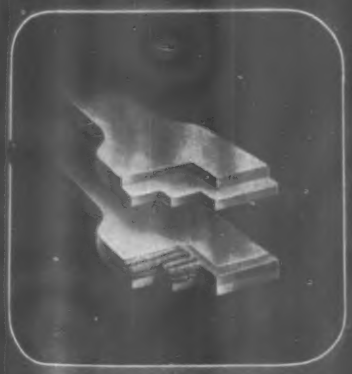
Announcing . . . !

A COMPLETE NEW LINE OF
ARCALOY TOOL STEEL ELECTRODES



Tools are Money!

SAVE THEM WITH ARCALOY



The new Arcaloy Tool Steel arc-welding electrodes provide tremendous possibilities in repairing and rebuilding tools and dies, and also in the composite fabrication of new dies needed for retooling.

The tempering curve of the deposit weld metal "as welded" of these electrodes will match that of the corresponding type of tool and die material.

Manufactured in six types. Sizes 3/32, 1/8, and 5/32 inches.

ARCALOY HIGH-SPEED Tool Steel Electrodes are used for compositely building tools for a wide range of cutting conditions, and for repairing all types of High-speed steel tools.

ARCALOY AIR-HARDENING Tool Steel Electrodes have many die applications such as cold extrusion dies, blanking dies, drawing dies and rings, and diversified uses in jig and fixture and frictional applications.

ARCALOY WORK-HARDENING Electrodes (austenitic) provide a weld deposit that will increase in hardness after being worked, find many applications in tool and die repair and fabrication.

ARCALOY OIL-HARDENING Tool Steel Electrodes are used to repair or rebuild tools or dies of oil-hardening types, also to fabricate composite units where low speed cutting qualities are desirable on working surfaces.

ARCALOY HOT-WORK Electrodes are used to repair typical Hot-work steels and also to fabricate composite units where Hot-work characteristics are wanted on working areas.

ARCALOY WATER-HARDENING Electrodes are used for repairing all water-hardening tool alloys.

Available Now

NEW
ENGINEERING DATA

Arcaloy's new tool steel welding engineering data book containing tempering curves for Arcaloy and typical tool steels as well as other pertinent tool steel welding information is available now.

Write on your letterhead for a copy.

Look for us at the
CLEVELAND METAL SHOW
BOOTH E642

Alloy Rods Co.

YORK, PA.

World's Largest Manufacturers of Stainless Electrodes

WHEEL LIFE Up 4 to 1.. with CORTLAND WHEELS

. . . on ship builder's steel welds

Once again Cortland Grinding Wheels go into a War Production Test against competitive wheels—*and win out by a wide margin.* This time they tackle the tough job of cutting and grinding steel welds on steel plates for a New York State shipbuilder—and they cut and grind *four times as many welds as the wheel formerly used!*

HERE ARE THE PRODUCTION TEST FACTS:

WORK: Steel welds on steel plates for deckhouses. *Material:* hard, bullet-resisting steel. *Size:* 5 feet by 10 feet. *Machine:* Chicago Pneumatic Tool-Air Grinder. *Wheel Speed:* 4200 R.P.M.

RESULTS: 2200 pieces were ground by the Cortland Type 11 Resinoid 6" diameter Flaring Cup Grinding Wheels. Average life of wheels was three weeks, or four times more than that of competitive wheels, which were of the same general type and size.

Almost invariably Cortland Grinding Wheels for all types of work can improve your present production in speed, efficiency and more work per wheel. Why not let us make tests and recommendations . . . without cost or obligation?

15

For better Weld Grinding

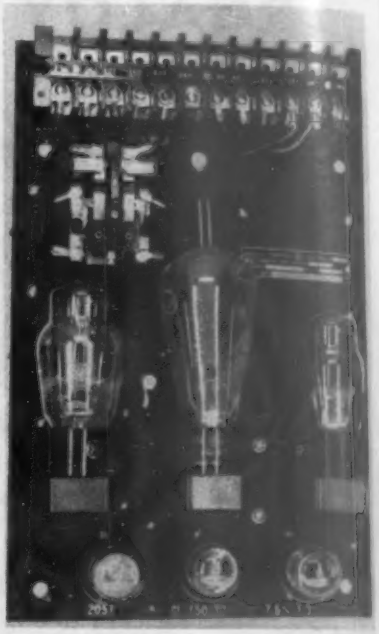
CORTLAND

CORTLAND GRINDING WHEELS CORP.

15 CORTLAND STREET CHESTER, MASSACHUSETTS

Forge-Pressure Timer

★ An electronic forge-pressure timer has been incorporated in the G-E line of capacitor discharge controls for use with



Close-up view of new G-E electronic forge-pressure timer.

stored-energy resistance welders. This timer is calibrated in milliseconds and functions to supply accurately timed forge pressure. It can be added to any capacity discharge control of this manufacture already installed, providing that the resistance welder has a dual-pressure system designed for this purpose. **General Electric Co.**, Schenectady, N. Y.

SS10 soldering stand. The operator is protected against injurious fumes, and attention is focused on the soldered joint by means of the plate glass window.

Soldering Stand

★ Model SS10 soldering stand is supplied with a cast bracket for mounting it on assembly tables but if desired it can be supplied mounted on a wood base. It has a fume stack 3 by 9¼ by 32 in. high and a shield fitted with a plate glass window (or with a magnifying glass for fine work). Department SS, **Ess Specialty Corp.**, Bergenfield, N. J.

Your Never-Failing Source of Quality Electrodes for Every Type of Weld

The reasons for the superior performance of Reid-Avery Electrodes can be stated simply and briefly: Twenty-five years' experience, the best and most modern equipment plus skilled craftsmanship constantly guided by advanced laboratory procedure. • It is under such favorable conditions that each of the following complete list of Reid-Avery Electrodes is produced.

ELECTRODE	A.W.S. CLASSIFICATION	MATERIAL TO BE WELDED	TYPE OF WORK	CURRENT
RACO 7	E-6010	Mild Steel	All Position	Rev. Pol.
RACO 11	E-6011	Mild Steel	All Position	A.C.
RACO 8	E-6012	Mild Steel	General Purpose Poor Fit-up	Str. Pol. or A.C.
RACO 8	E-6013	Mild Steel	General Purpose Light Gauge	Str. Pol. or A.C.
RACO 6	E-6020 E-6030	Mild Steel	Butts, Positioned Fillets and Deep Grooves	A.C. or D.C.
RACO 20	E-6020 E-6030	Mild Steel	Single Pass - Fillets or Grooves	A.C. or D.C.
RACO 5	E-6030	Mild Steel	Deep Grooves	A.C. or D.C.
RACO 82	None	Steel	All Position Wear-resisting Machinable	Str. Pol. or A.C.
RACO 74	E-7010	High Strength Steels	All Position	Rev. Pol.
RACO 64	E-7020	High Strength and	Butts, Positioned	A.C. or
RACO 13	E-7030 E-6013	Silicon-killed Steels Mild Steel	Fillets and Deep Grooves General Purpose	D.C.
TYPE D	E-4511	Mild Steel	Poor Fit-up	A.C. or
TYPE D	E-4521		Automatic or	D.C.
30-40 C	None	Steel	Manual	Str. Pol.
TYPE M	E-4511	Mild Steel	Automatic or Manual, Wear-resisting Machinable	Str. Pol.
BLUE	E-4521		Automatic or	
LABEL	E-4510 E-4520	Mild Steel	Manual	Str. Pol.
RACOLLOY 19-9	None	Stainless and Air-Hardening Steels	Welding and Surfacing	Str. Pol.
RACOLLOY 25-20	None	Stainless and Air-Hardening Steels	Welding and Surfacing	Rev. Pol. or A.C.
				Rev. Pol. or A.C.

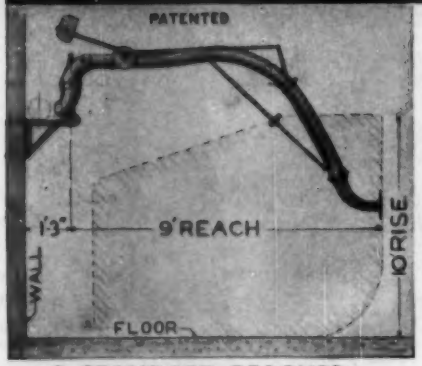
The

REID-AVERY COMPANY

DUNDALK BALTIMORE 22 MARYLAND

SINCE 1919 • PRODUCERS OF ARC WELDING ELECTRODES AND WELDING RODS

GET RID of WELDING FUMES!



3 STANDARD REACHES:
3 ft., 9 ft. and 15 ft. radius. Arm extended for maximum reach. Note very wide working range.

RUEMELIN Fume Collector DRAWS OUT GASES, SMOKE and HEAT *at the Source!*

Solve your fume problems quickly and efficiently by installing Ruemelin Fume Collectors. Powerful suction draws out noxious gases, smoke and heat *at the source.* Guards employee health, resulting in less welder fatigue, therefore greater plant output. Has many exclusive features: (1) Clears shop air with minimum loss of building heat. (2) Exhaust snout can be positioned instantly and conveniently. (3) Covers maximum welding territory, vertically, horizontally and by circle swing. (4) Shipped completely assembled, easy to install. Thousands of Ruemelin Fume Collectors now serving war industries everywhere.

We gladly offer engineering service for your fume collector installation. Write for Bulletin 37-C.

RUEMELIN MANUFACTURING COMPANY
3880 NORTH PALMER STREET MILWAUKEE 12, WIS., U. S. A.

RUEMELIN
SAND BLAST EQUIPMENT · TUBULAR DUST FILTERS

Precision Form Grinder

★ **Norton Company,** Worcester 6, Mass., has acquired all design and mechanism patents and all manufacturing and sales

"Norton Bura-way" grinder for precision duplication of tools' original cutting edges.

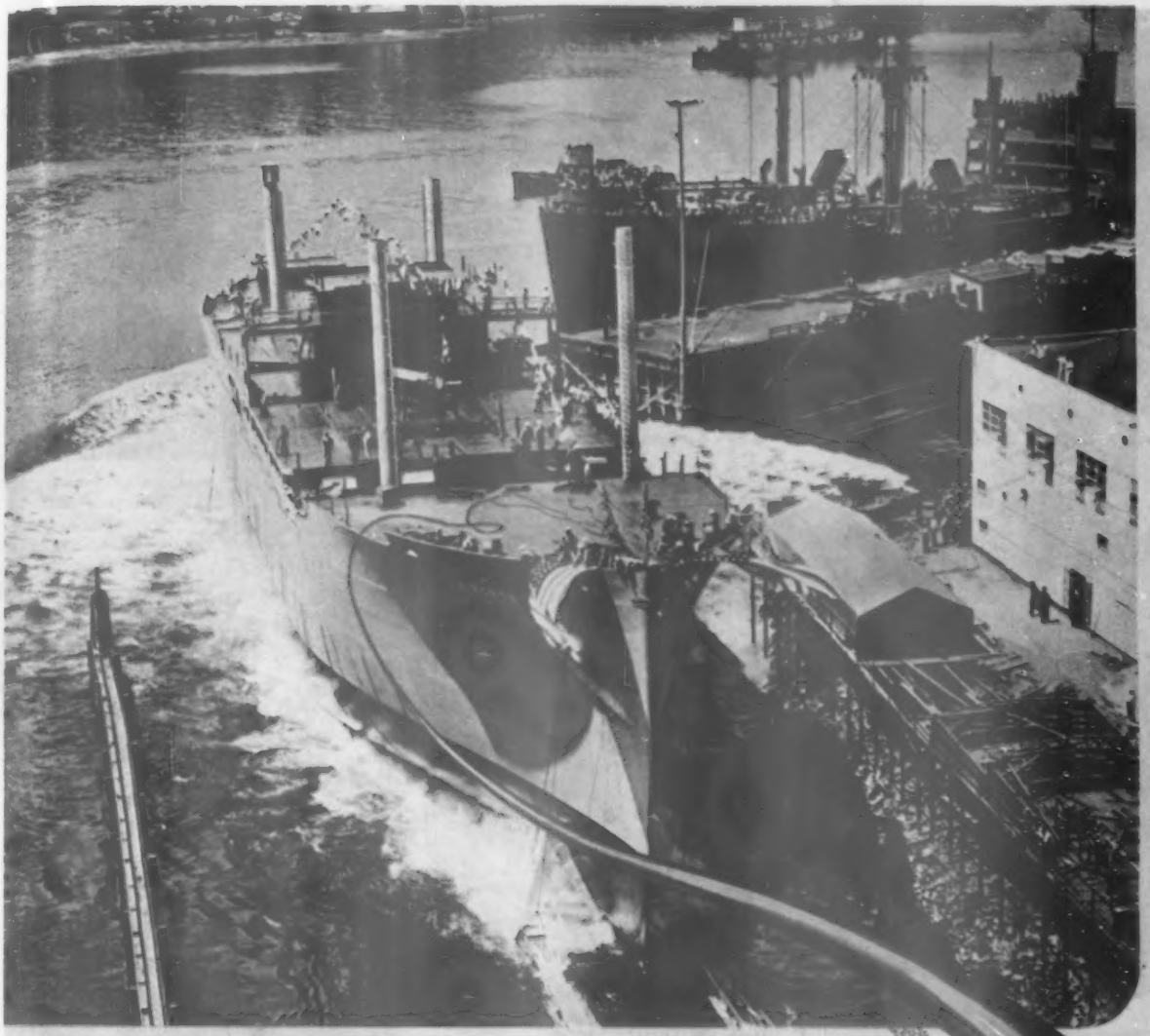
rights pertaining to the "Bura-way" grinder, which will henceforth be built and sold under the name "Norton Bura-way." This machine was designed for tool sharpening in accordance with the growing belief that cutting tools should have "constant relief in the direction of feed." Added factors which should contribute to longer tool life are: a means of precise control in grinding tool angles, close control of the amount of metal removed in renewing cutting edges, precise reproduction of form tools within close dimensional limits and the production of a fine-surface finish at the tool's edge. Relief angles, it is stated, are controllable within minutes of arc.

The unit, now equipped for wet grinding, is reported equally suited to the rough or finish grinding of tools, and it will handle high-speed and cast-chromium-cobalt steels as well as carbide-tipped tools.

» «

Fire Extinguisher Locater

★ The cry of "FIRE" can be doubly terrifying to the employee who can't see or remember the exact location of the nearest fire extinguisher. To make it easier for him to act promptly in the emergency, **Randolph Laboratories, Inc.,** 8 East Kinzie St., Chicago 11, has developed a new decal water-transfer sign that can be placed instantly above all extinguishers in the plant area. Measuring 10 in. in diameter and printed in large white letters on a bright red background, this "locater" is said to be visible up to a distance of 75 ft if it has been properly placed.



Oregon Shipbuilding launching of the first AP5 combat troop transport built in the U. S.

WELDING helped speed the first AP5 troop transport down the ways

Arc welding hastened construction on the first AP5 troop transport built in the United States, and the huge quantities of Belden cable used helped speed welding.

Highly flexible, Belden cable reduces welders' fatigue, increases accuracy. Tough and durable, it stands up under long service and abuse—cuts time losses caused by frequent cable replacements.

Specify Belden

Belden Manufacturing Company
4677-A W. Van Buren St., Chicago 44, Ill.

Belden welding cable is used in shipbuilding operations from laying the keel to the final outfitting.

Photos courtesy of Oregon Shipbuilding

Belden *Welding* **CABLE**

Awarded the U. S. Treasury Special Citation of Merit for initiating the War Bond-or-Cash Dividend Plan

Fewer rejects, more consistent welds

WITH **Titan**

BRONZE WELDING RODS . . .

When intricate sections of cast iron, malleable iron, wrought iron, galvanized iron, brass and bronze or steel must be quickly and economically welded, you will get best results with Titan Bronze Welding Rods.

Among the factors contributing to Titan's superiority in welding alloys are: use of only the purest of raw materials, scientific joining of these materials, strict laboratory control of mixtures and casting temperatures (known as Double Deoxidation), resulting in greater strength, uniformity and ductility.

Titan Welding Rods are used on repair and production work from coast to coast and have proven their ability to speed up production.

Titan

METAL MANUFACTURING CO., BELLEFONTE, PA.

NEW YORK • CHICAGO • SAN FRANCISCO

Quality Alloys By Brass Specialists

Brass and Bronze Rod • Forgings • Die Castings • Welding Rods

Pipe Gauge

★ A new model of the "Three-Point" pipe gauge will measure instantly all sizes of pipe from ⅛ to 12 in. as well as

"Three-Point" pipe gauge measuring 1¼ in. electrical conduit.

all sizes of electrical conduit and metallic tubing (thin-wall tubing). This pocket-size gauge consists of two pivoted steel plates with curved edges. When contact is made at three points with the pipe or tubing to be measured, the conduit or pipe size can be read directly on the scale as well as the drill size to tap. Inch and metric rules are also included. The gauge measures 2¾ by 4½ in. when closed, and it is available with or without a leatherette case. **Three-Point Gage Co.**, 3821 Broadway, Chicago 13.

Randall tip cleaner. The size is marked at the end of the plastic case.

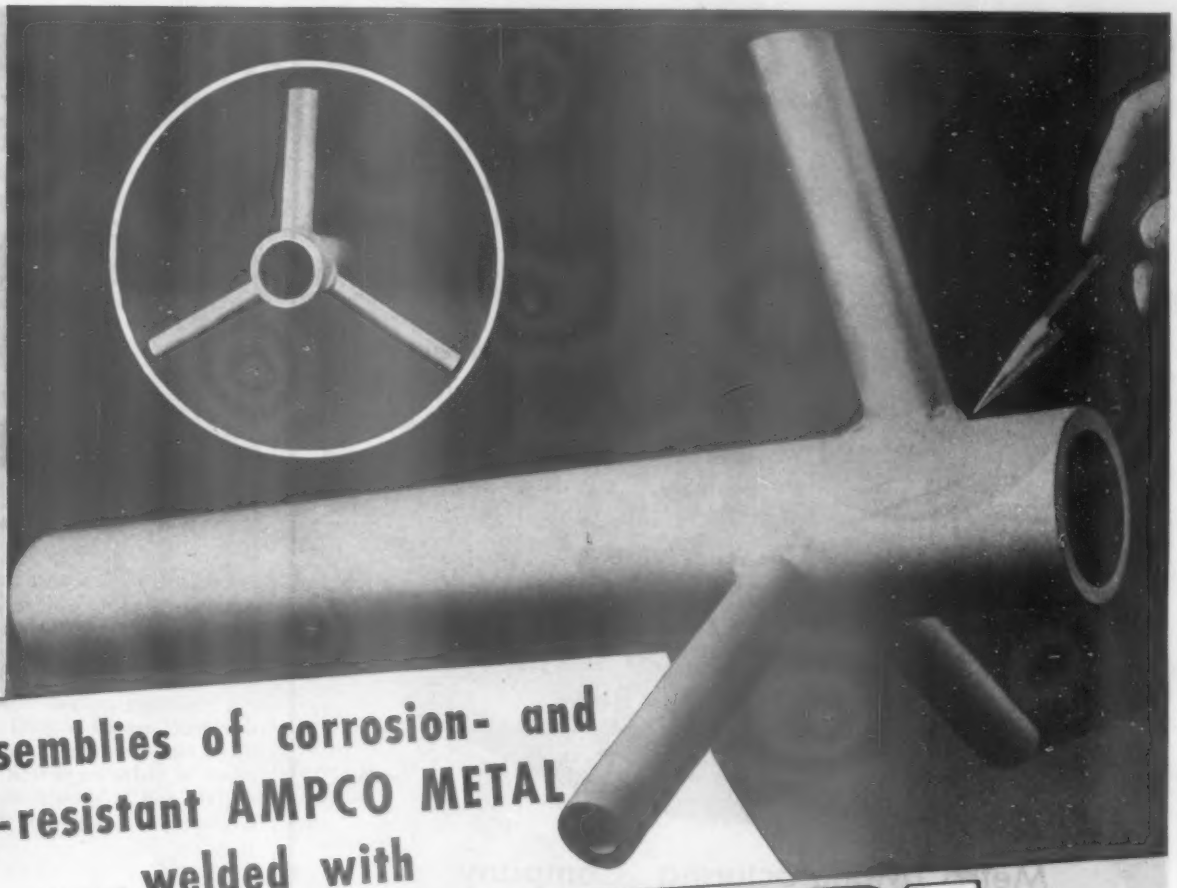
Tip Cleaners

★ Randall tip cleaners are made in any size for welding and cutting torches and are enclosed in a plastic case which has the sizes it contains marked on the ends. The cases for cutting torches contain two cleaners: one size for preheat and the other for the cutting orifice. The cases for welding tips hold one cleaner, of the size marked. **Welding & Cutting Materials Co.**, 400 East 18th St., Kansas City 8.

» «

Hydraulic Vise

★ The Reimuller precision "V-way" hydraulic vise is foot-operated and adapted to quick set-ups on drill press, lathe, milling machine, grinding or bench jobs. Two levers are used in the foot control: one to apply pressure up to the rated tonnage and the other for release (with a two-speed return). There are two sizes: a four-ton vise with a 4-in. opening and a seven-ton vise with a 7-in. opening. **Reimuller Bros. Co.**, 9400 Belmont Ave., Franklin Park, Ill.



Sub-assemblies of corrosion- and wear-resistant AMPCO METAL . . . welded with

AMPCO-TRODE

COATED ALUMINUM BRONZE ELECTRODES

. . . cost less, and last several times as long

Here is another successful application of Ampco-Trode, to complete the fabrication of a corrosion-resistant unit. In this particular case, and in the original construction of many other types of equipment where metal is exposed to corrosion, wear, shock, or fatigue, Ampco-Trode coated aluminum bronze electrodes deposit weld metal comparable in strength, ductility, and hardness with the various grades of cast Ampco Metal—and successfully weld almost any combination of dissimilar metals, giving a weld with excellent physical properties. Five grades of Ampco-Trode are available to meet your specific needs. With tensile strength up to 80,000 psi and hardness to 352 Brinell, Ampco-Trode is recognized as ideal for such purposes as illustrated above.

Nation-wide distribution enables you to secure Ampco-Trode quickly. Consult with your supplier or write us for information. W-78

AMPCO Reg. U.S. Pat. Off.

Ampco-Trode is a product of

Ampco Metal, Inc.

Tear out and MAIL THIS COUPON

Ampco Metal, Inc., Dept. WE-10, Milwaukee 4, Wisconsin

Please send me Ampco-Trode bulletin and data on welded assemblies.

Name..... Position.....

Company.....

Address.....

City..... (.....) State.....

Metro Safety Equipment

Metro's Welding Helmets

We offer a complete line of Welding Helmets.

SEND FOR OUR NEW CATALOG.

Metro's New Coveralls

Black for welders (as illustrated below). For chipping and grinding, **transparent** coveralls with shatterproof lenses are available.

DISTRIBUTORS WANTED

Metro Manufacturing Company

38-11 Thirty-first Street Long Island City 1, N. Y.

W-AL-CO RODS

for welding of aluminum

GAS WELDING RODS

(Flux-Coated)

Type G-43—5% Silicon-Drawn Aluminum

Type G-25—Pure Drawn Aluminum

*Types G-142, G-195, G-355 and G-356—Aluminum Alloy for welding CAST ALUMINUM

Send for descriptive circular.

*Available in $\frac{1}{16}$" size only

ARC WELDING ELECTRODES

(Flux-Coated)

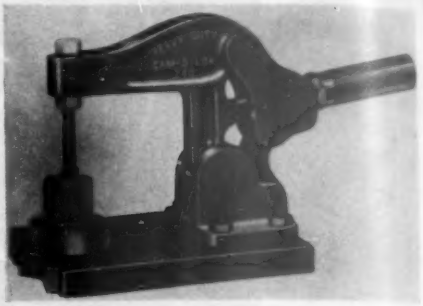
Type E-43—5% Silicon-Drawn Aluminum
Type E-25—Pure Drawn Aluminum
*Types E-142, E-195, E-355 and E-356—Aluminum Alloy for welding CAST ALUMINUM

Assure dense, ductile, strong welds. Ease of Control; Free-Flowing Characteristics; Increased Welding Speeds.

WELDING ALLOYS MFG. CO. 744 Broad St., Newark, N. J.

Fast-Working Clamp

★ Made in three types, for light, medium or heavy duty, the new "Cam-O-Lok" clamp is said to be instantly adjustable over the entire range of its vertical hold-



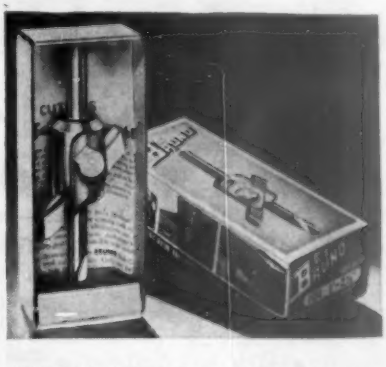
Heavy-duty "Cam-O-Lok" clamp.

ing capacity. Locking and unlocking are accomplished by means of a threaded element in the positioning handle. No special adjustment of the hold-down bolt is necessary to obtain the desired clamping pressure when objects varying in thickness are to be held. Dimensions of these clamps have been held to a minimum in order to permit their use in assembly and holding fixtures where space is limited. **Mechanics Engineering Co.**, Jackson, Mich.

» «

Adjustable Hole Cutter

★ A new all-purpose adjustable hole-cutting tool is said to cut smooth holes in steel or other metals as well as in wood, fibre, plastics, etc. One model cuts



Adjustable hole cutter for drill press use.

holes from $\frac{5}{8}$ to $1\frac{1}{4}$ in. diameter through $\frac{1}{8}$ in. thickness, and another model cuts holes from 1 to $2\frac{1}{2}$ in. through thicknesses up to $\frac{3}{8}$ in. The tools are designed to operate in light drill presses, portable drills or breast drills and are also available with square shanks for use in hand braces.

The Bruno hole cutter consists of a drill which starts the hole and serves as a pilot and a hardened body with a milled slot, into which is set a high-speed tool bit. Adjustment is obtained by loosening the hexagonal bolt and sliding the blade to its correct distance from the pilot. **Bruno Tools**, 93330 Santa Monica Boulevard, Beverly Hills, Calif.

COMPLETE PORTABLE SHAPE CUTTING FACILITIES NEVER BEFORE AVAILABLE—SO ECONOMICALLY

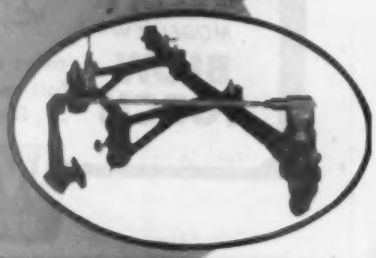
The New, Popular Priced GASO V-10 with Automatic Shape Cutting Attachment

Two Machines In One

(1) **Automatic Straight Line Cutter**

(2) **Automatic Shape Cutter**

- Portable, Motor Driven
- Fully Automatic on All Shapes
- Adjustable 3" — 60" per minute
- Instant Start and Stop
- Rotary Shut-off Valve



Shape Cutting Attachment

To the popular uses of portable cutting machines there has now been added the luxurious control-ease and accurate shape cutting reproduction of high priced shape cutting machines. Every Steel Fabricating Shop needs the new popular priced GASO V-10 with automatic shape cutting attachment.

TRACING IRREGULAR SHAPES—Using a full size drawing, blue print or sketch, irregular shapes are easily machine-cut by guiding the wheel on the tracing head over the drawing. One or more machine torches mounted on the other end of the attachment, duplicate in flame cutting the path of the wheel movement.

SPINDLE HEAD OPERATION (Optional attachment)—To speed up the production of small quantities of duplicate shapes—a Spindle Head Attachment is recommended. This unit replaces the Tracing Head on the V-10 Shape Cutting Attachment. In this operation the Spindle Head is kept in contact with the contour of a wood pattern.

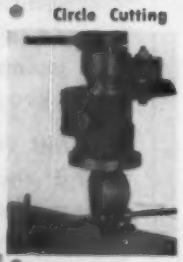
CIRCLE CUTTING—A "simplicity-plus" circle cutting attachment may be joined to the Tracing Head Assembly to cut out circles from 2" to 16" diameter. The radius rod is scale marked in inches to speed up the set-up time. Tracing Head and Circle cutting attachment are furnished as standard equipment with the GASO V-10 SHAPE CUTTING ATTACHMENT.

TEMPLATE HEAD OPERATION (Optional attachment)—When large quantities of duplicate parts are to be flame cut—a Template Head is used. This consists of two parallel steel rollers—rotating horizontally. The wheels contact the metal bar track between them and automatically follow the track contour. The Cutting Torch movement on the other end of the GASO CUTTING ATTACHMENT, duplicates the contour movement with precision flame cuts. Full instructions on how track contours can be made, are supplied with the Template Head.

- Tracing

- Following Patter

- Circle Cutting



- Following Templa

Gaso Cutting Accessories : Gaso Steel Cutting Machine Table • Torch Holders for Multiple Hook-up

Manufactured By

GASO EQUIPMENT COMPANY

3253 North Kedzie Avenue **Chicago**

Safe Welding

AT LOWER PRODUCTION COSTS

The Weldit Gasaver shuts off the welding flame when not in use. . . . Conserves essential materials by cutting oxygen and acetylene consumption as much as *fifty* per cent. Prevents injury to workmen—or sudden fires—from dangerous idle torch flames. . . . Adjustment remains unaltered between welds.

When the Weldit Gasaver has been installed, you simply hang idle torch on the handy lever rod. Weight of torch pulls rod down, thus automatically shutting off supply lines. Relight instantly by passing torch over Gasaver pilot light. No bother. . . . No time lost. . . . *No readjusting required.* . . . Price $10.00 at Detroit. Order today.

Better Soldering, Annealing and Heating Jobs

The Weldit Model CW Blowpipe is in daily use by many foremost industrial plants. . . . Built in accordance with the recommendations of leading fabricators of sheet metal products. . . . Operates on either natural gas, manufactured gas, or other low temperature fuel gas and compressed air. Stands up under rough shop use. . . . Send for literature.

WELDIT ACETYLENE CO.
628 BAGLEY AVENUE · DETROIT 26, MICH.

Off the Floor Deliveries!

ON
TRINDL SUPER INDUSTRIAL **ARC WELDER**

DESIGNED FOR HIGH SPEED PRODUCTION ARC WELDING

TRINDL SUPER INDUSTRIAL ARC WELDERS, the result of many years of careful engineering and "job tested" research, are rolling up impressive production records. Acclaimed for superior performance, ruggedness, dependability, and economical operation.

For better, faster welding, easy-to-operate TRINDL SUPER INDUSTRIAL ARC WELDERS will help step up your production schedules 20% to 40%. Manufactured in a range of distinctive sizes to accommodate every type of shop and production welding job.

Trindl Welders, Electrodes, supplies and accessories, available for immediate delivery, will save you both time and money. Write, wire or phone for full details.

TRINDL PRODUCTS, LTD. 17 EAST 23rd STREET AR CHICAGO 16, ILL.

Air Foot Valve

★ A new foot valve to be used with air tools, air cylinders, flash welders, air chucks, air vises and other equipment

Keller foot valve for flash welders and other compressed-air-operated equipment.

operating on compressed air is announced by the **Keller Tool Co.**, Grand Haven, Mich. When the foot pedal is depressed, the exhaust closes, admitting line pressure to the device; upon release of the pedal the air supply stops. This valve is furnished in both locking and non-locking types; in the former a pedal lock holds the pedal in the open position until the lock is released by touch of the operator's toe. A simple adjustment of the lever-locking device will change the locking pedal to the non-locking type.

» «

Time Delay Relay

★ The Cramer Model TD6 time delay relay has a cam-operated switch mechanism enclosed in a dustproof and moisture-

This panel-mounted time delay relay is protected against dust and moisture.

tureproof bakelite case for panel mounting. Open and closed positions are indicated by means of a graduated dial. Four screw-type terminals for motor and switch circuits are provided. **R. W. Cramer Co., Inc.**, Centerbrook, Conn.

» «

Fire Extinguisher

★ **Randolph Laboratories, Inc.**, 8 East Kinzie St., Chicago, has produced a 25 lb wheel-type carbon-dioxide fire extinguisher that features an uninterrupted sweeping action. By grasping the handle, the operator can move the unit and press the release button with one hand, discharging a smothering blanket of carbon-dioxide snow in a large arc of 10 to 20 ft.

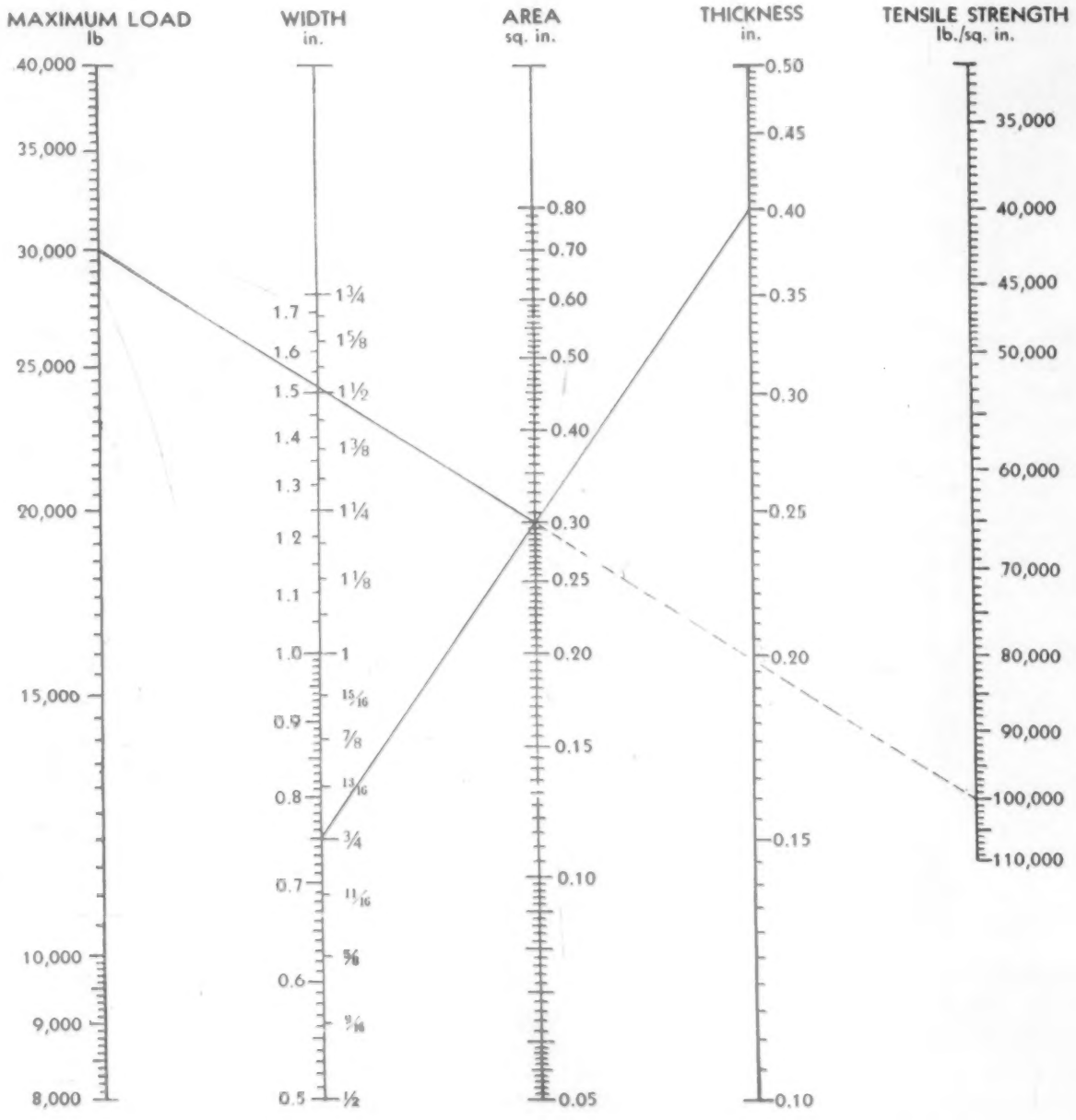
ALIGNMENT CHART

For Computing Tensile Strength

Key: Given a specimen 0.4" thick and 0.75" wide failing at 30,000 lb. load.

1. Area of 0.30 sq. in. is indicated on line joining Width and Thickness.
2. Tensile Strength of 100,000 lb./sq. in. is indicated on line joining Area with Maximum Load.

Tensile Strength = Maximum Load ÷ (Width × Thickness).



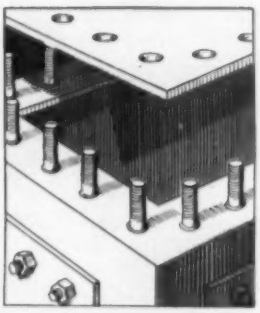
Courtesy, Air Reduction Sales Co.

SEE THIS "GUN" AT THE NATIONAL METAL CONGRESS CLEVELAND, OHIO OCTOBER 16-20

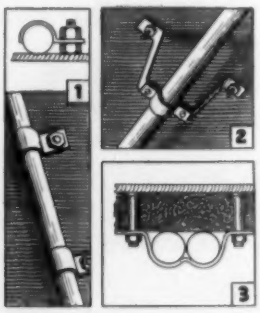
NELSON *Electric Arc* STUD WELDERS

—end-weld studs in less than one-half second!

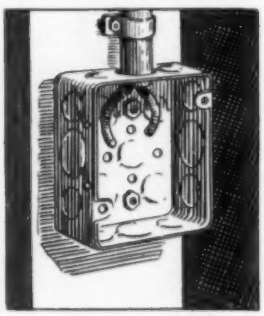
SOME WAYS 460 INDUSTRIAL PLANTS AND SHIPYARDS ARE USING IT!



Inspection covers of all types can be secured with Nelson Studs. No drilling holes through casings, or hand welding studs. Studs are automatically welded in less than ½ second. No leaking, no loosening! The weld is stronger than the stud.

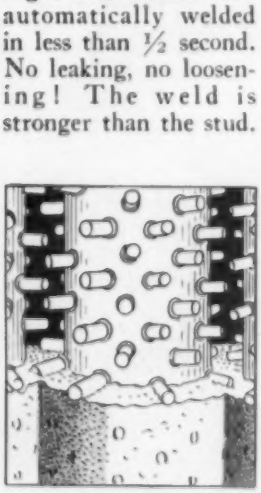


Wiring, conduit, and pipe are quickly secured. Here illustrated are a few of many methods: 1. Securing conduit. 2. Securing pipe (single or multiple runs). 3. Securing wiring of all kinds over soft insulation materials.



Electrical equipment of all kinds, outlet boxes, circuit breakers, etc., can be secured without drilling metal beams or welding small pads. Accurate locating is easy because all Nelson Studs are pointed. The economical way to secure small parts.

Metal Lath Studs are welded and the insulation impaled or sprayed on over them. Slotted washers secure the insulation. The metal lath is laid and secured by bending over the stud head. It lies flat so it is easily covered with the plaster.



Studding boiler tubes increases their efficiency. Studs act as reinforcement for the ceramic material which is put on to conduct heat to the tubes. The stud also conducts heat into tube. Nelson Studs save time and material.

The Nelson Stud Welder is completely portable and light in weight. Proven by five years of actual use and used by more than 460 industrial plants it can be employed wherever there is need to end-weld studs to metal. Excellent for repair and maintenance work of all kinds. *Write to the address below for complete details and catalog.*

Cutaway view shows complete fusion of weld between stud and plate. *The weld is stronger than the strength of the stud.*

NELSON SPECIALTY
WELDING EQUIPMENT CORPORATION
Dept. W, 440 Peralta Avenue, San Leandro, Calif.

Eastern Representative: Camden Stud Welding Corp. Dept. 122, 1416 So. Sixth St., Camden N. J.

Flame-Softening

Q—How is flame-softening accomplished and what is its purpose?—*R. O. S.*

A—Flame-softening is in reality the opposite of flame-hardening. In this application, the heat from one or more oxy-acetylene flames is applied under carefully controlled conditions either as preheating, postheating or both.

The various softening applications may be for the purpose of: (1) softening flame-cut edges of air-hardened steels, particularly high alloy and high tensile steels which when flame-cut by ordinary methods may lack toughness, ductility and in some cases machinability; (2) localized annealing of fully hardened or case hardened parts to permit drilling, tapping and machining; (3) grain refining or finishing weld passes; (4) annealing sheared edges or other work-hardened parts.

» «

Welding Clad Steel

Q—What is the best procedure to follow in the welding of nickel-clad or stainless-clad steels?—*R. R. N.*

A—The first point to remember in the welding of clad steels is to obtain a continuous surface of the clad material so that all corrosion-resistant properties will be maintained. Heavy steel plate is welded generally by the metal-arc method, and consequently this is the most important (and preferred) method to be considered in welding nickel or stainless clad steel. Tanks that must be erected in the field can be welded in any position, both on the steel and clad sides.

In general, the most commonly used procedure for arc welding clad plate, particularly with beveled butt joints, is as follows: (1) assemble the vessel by tacking from the steel side; (2) complete the weld on the steel side; (3) chip out the clad side of the butt joint, using a round-nose gouge, to leave a clean groove as narrow as practicable in which to deposit (in the case of nickel-clad steel) the nickel weld metal; and (4) deposit one or more beads of nickel weld metal into the chipped groove, to provide a continuous nickel interior surface.

» «

Thermit-Welding Applications

Q—Where is thermit welding used? —*G. H. S.*

A—Thermit welding is used primarily in the welding of large sections and especially for the repair of rolling mill parts, locomotive frames, stern posts, motor castings and connecting rods. In production welding, thermit is used extensively in the welding of railroad rails and large pipes.

An Important Message to
Technical Men

The war has carried the engineering age to a new peak! Production demands have created technical problems the like of which the world has never seen before! The services of engineers are at a premium. Especially the services of one particular class—executive engineers—*engineers with business training;* engineers who can "run the show."

In these critical times, the nation needs engineers of executive ability *now, today*—not five, or ten years from now! The shortage of such men is acute—even more acute than that of skilled production workers. And company heads, aware of this situation, are offering high rewards to engineers who have the necessary training in industrial management.

Golden Opportunity for Engineers

In this new era, the engineer with vision and foresight has a golden opportunity. He will realize that out of today's tremendous production battles will emerge technical men who not only will play a major role in winning the war, but who also will be firmly entrenched in key executive positions when peace comes.

However, before the engineer can take over executive responsibilities, he must acquire knowledge of the other divisions of business—of marketing, accounting and finance. He has of necessity a vast amount of technical training and experience. But in order to grasp the opportunities that present themselves today—to assume leadership on the production front—he must *also* have an understanding of practical business principles and methods.

The Alexander Hamilton Institute's intensive executive training can give you this essential business training to supplement your technical skill. It is a time-saving program that fits into the most crowded schedule. It is not intended for men who expect to remain just engineers for the rest of their lives. It is for those willing to train for the position that now seems just a little beyond them—the position which will increase their incomes today and make their security more certain when the war has ended.

134,000 men on the operating side of business have enrolled for this training. More than 37,500 are technical men—engineers, chemists, metallurgists—many of whom are today heads of our huge war industries.

This training appeals to engineers because it gives them access to the thinking and experience of the country's great business minds. It is especially valuable to such men because it is basic, not specialized—broad in scope, providing a thorough groundwork in the fundamentals underlying *all* business. It covers the principles that every top executive must understand. It applies to all types of industrial organizations, because all types of organizations are based on these same fundamentals.

Business and Industrial Leaders Contribute

The Institute's training plan has the endorsement of leading industrialists and business men. And it is only because these high-ranking executives recognize its value and give their cooperation that such a plan is possible. Among those who contribute to the Course are such men as Frederick W. Pickard, Vice President and Director, E. I. DuPont de Nemours & Co.; Thomas J. Watson, President, International Business Machines Corp.; James D. Mooney, President, General Motors Overseas Corp.; Clifton Slusser, Vice President, Goodyear Tire and Rubber Co. and Colby M. Chester, Chairman of the Board, General Foods Corp.

Send for "FORGING AHEAD IN BUSINESS"

The facts about the Institute's plan and what it can do for you are printed in the 64-page book, "Forging Ahead in Business." This book *in* its own right is well worth your reading. It might almost be called a handbook of business training. It is a book you will be glad to have in your library, and it will be sent to you without cost. Simply fill in and mail the attached coupon *today.*

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News of the Industry

Non-Ferrous Metals Freed for Gas Welding and Cutting

The War Production Board last month revoked Limitation Order L-268, thus lifting restrictions on the use of non-ferrous metals for the production of oxy-acetylene equipment used in welding, preheating, metal spraying and cutting. The revoked order is superseded by Order L-123 (General Industrial Equipment), which requires a preference rating of AA-5 or better for the delivery of oxy-acetylene apparatus unless deliveries are to be made in accordance with Priorities Regulation No. 24.

» «

AWS to Receive Ordnance Award

Attesting to the contributions of the American Welding Society to ordnance progress in this war, the Ordnance Distinguished Service Award will be presented at the opening session of the 25th annual meeting in Cleveland. This award is a diploma bearing the traditional seal of the Ordnance Department, and it is awarded in recognition of scientific and engineering achievement.

In a letter to AWS President David Arnott, Major General L. H. Campbell, Jr., Chief of Ordnance, said in part:

"It is my pleasure as Chief of Ordnance of the Army to tell you on behalf of the Ordnance Department that I am most grateful for the outstanding contributions the American Welding Society has made to ordnance progress in this war. The degree of that progress is best shown by the success of our fighting forces in all theatres of operations."

» «

New Westinghouse Films for Electronics Training Course

Sound slide films, lesson books, quiz books and an instructor's manual have been prepared by Westinghouse for a new ten-part training course designed to present the basic principles and applications of electronics in a clear, understandable manner.

Subjects covered by the course are:

Part I. Electronics and the electron theory of matter; electron movement during current flow through metal conductors; emission of electrons and their controlled flow through vacuum and gases.

Part II. Theory of current rectification by vacuum tubes; kenotrons—high-voltage, low-current rectifiers.

Part III. How gas in a tube neutralizes space charge; gaseous rectifier tubes.

Part IV. Electronic amplification.

Part V. Electronic generation of high-frequency alternating currents.

Part VI. Electronic oscillators for radio and carrier-current transmission.

Part VII. Basic circuits for electronic control.

Part VIII. Industrial applications of electronic regulation.

Part IX. Industrial applications of electronic control.

Part X. Electronic conversion of light into electricity and electricity into light.

Although designed primarily for Westinghouse employees, the material has been made available at reproduction costs to outside engineering groups and individuals interested in electronics. It is recommended that twenty hours be allowed for the full 10-part course, with two-hour classes being held one night each week.

» «

Welding Distributors to Meet in Cleveland

In order to give its members the opportunity to attend any of the sessions planned in connection with the Metal Show, the Welding Distributors Association will hold its second annual meeting in Cleveland, October 14, 15 and 16.

C. I. MacGuffie, manager of the electric welding division of the General Electric Co., and members of his staff will be on hand to help with the solution of production and distribution problems.

Why put up with 3 Months' Life when tires like these last a year or more?

IN THIS FOUNDRY where a set of Simpson tires are working in silica sand, the normal life of an ordinary tire is only three months! But now, since the tires have been given a hard-facing overlay of Coast Metals, no appreciable wear is evident after a year's continuous service!

By making parts, that are subjected to wear, exceptionally resistant to abrasion, impact, and shock, Coast Metals hard-facing assures longer equipment life. It eliminates the need for frequent repairs and replacements, reduces shutdowns, and steps up production.

Easily applied either by the electric welding arc or the oxy-acetylene torch to new or old parts of ferrous metals, Coast Metals hard-facing is today's wartime answer to solving difficult wear-resistance problems. Our engineers will gladly tell you how it can meet *your* particular needs.

COAST METALS, INC.

Plant and General Offices: Canton, Ohio • *Executive Offices:* New York, N.Y.

COAST METALS *hard-facing weld rods*

YOUR EQUIPMENT'S LIFE PRESERVER AGAINST WEAR

PERFECTION

for Tomorrow's Welds

Your production welding in the future will need to be better than ever before, to measure up to consumer expectations of improved products. Your costs will need to be lower, too, because there will be active competition among many products for every dollar of purchasing power that exists.

PERFECTION Welding Electrodes will give you the performance that will make your position strong—and keep it strong. Their scientifically controlled quality allows deposits to be made consistently at high speeds without sacrifice of strength or soundness. Each type has the characteristics that make it easy to meet weld specifications.

Write today for your copies of the PERFECTION Welding Electrode Catalog and Comparison Chart.

THE ANTHONY CARLIN COMPANY

2717 East 75th Street

CLEVELAND 4 OHIO

ELECTRODES for SPECIFIC Welding Requirements

P-50X and P-50X (V & O)—for flat, vertical, horizontal and overhead welding of mild steel. High deposition rate and excellent contour of bead. Recommended for both repairs and new fabrication of rolled or cast steel. AWS-E6010.

P-60 and P-61—for single or multiple pass welding in any position on all types of mild steel sections. P-60 is especially suitable when fit-up is bad. P-61 is recommended for high heat applications and for strong arc action. Both leave smooth deposits with low spatter loss. AWS-E6012.

P-70—for flat faced (45°) fillet welds on mild steel sections in flat position. Used widely for single pass fillet welds in construction of ship subassemblies, large condensers, machine bases, etc., where size of section prohibits positions. AWS-E6020.

P-80—for code welding on pressure vessels and related work. Can be used at very high welding heats. Dense deposits are obtained, with low spatter loss. AWS-E6030.

P-100—for welding light gauge sheet metal with AC transformer machines. Deposit is smooth and uniform. AWS-E6013.

P-103—for flat, vertical, horizontal and overhead welding of mild steel with AC transformer machines. Recommended for AC code welding on pressure vessels. AWS-E6011.

P-110—for welding cast iron. Operates at low welding heat, thereby reducing hardening effect at line of fusion.

P-170 and P-180—for all position welding where the physical properties of an unshielded deposit are acceptable. Flow well and show excellent penetration. AWS-E4510 and E4511 respectively.

Moly-C-Alloy 1 and Moly-C-Alloy 2—for welding carbon moly and low alloy high tensile steels. AWS-E7010 and E7010 & E7020.

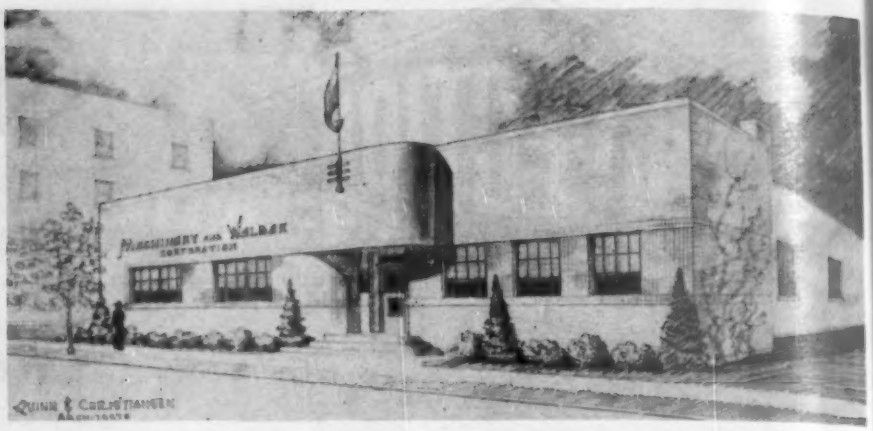
WRITE FOR CATALOG

Describes uses and characteristics of various PERFECTION Electrodes for use on mild steel, cast iron, carbon moly and low alloy high tensile steels.

Machinery and Welder Corp. Builds New Home in Chicago

Machinery and Welder Corp., Chicago distributor of welding supplies, expects to move during the first week of October into a newly built building at 1324-26 West Fulton St. The new building was put up to meet the steadily increasing requirements of the welding industry, and it a little better than doubles the company's present floor space. It is a one-story brick building having concrete floors to handle the heavy storage loads. Its all-welded roof, manufactured by the Airtherm Mfg. Co., St. Louis, is said to be unique in its ease of application and ease of construction.

The firm started in 1931 from a single office in Chicago and built its business up to the point where it now has branch offices in Moline, Ill., Milwaukee and St. Louis. The General Electric line of arc-welding equipment and the Arcos line of stainless-steel electrodes are among the products handled.



Architect's drawing of Machinery and Welder Corporation's new Chicago headquarters.

» «

$4,750 to Lincoln Employees for Postwar Planning Ideas

Fifteen employees of The Lincoln Electric Co. are sharing $4,750 in awards given in the postwar planning competition which ran from October, 1943, to July 1, 1944. Of the 15 prizes (which ranged from $1,000 to $100) four were won by men in the Lincoln factory and the other 11 were awarded to sales engineers in district offices all the way from San Francisco to New York City.

Jim Nicholl, foreman of the Lincoln shipping department, won the first prize of $1,000 with a suggestion for a deep drawn, automatically welded steel container for the export packing and shipping of electrodes. Nicholl's paper estimated that the savings in boxing costs and freight might run well over $25,000 per year if the steel containers replaced the present wooden boxes.

H. E. Cable, sales engineer from the Pittsburgh office, won second prize of $750 with an engineering study of a method whereby several thousand automatic welders might be sold.

D. J. Burke, maintenance department employee, won third prize of $600 for his design of a small positioning device for weldments.

Papers on remote control and automatic stop-start devices, a welded steel engine for engine-driven welders, appearance improvements and plans for making changes in the shop organization so as to have a six hour working day accomplish as much as an eight hour day were among the themes of the other prize-winning papers.

» «

Victor Opens Oakland Store

Victor Equipment Co., San Francisco, has opened a retail sales and service store across the bay in Oakland. E. L. Russell, veteran Victor service engineer, has been named branch manager of the Oakland enterprise, which is conveniently located at 312 12th St., in Zone 7.

HERE'S WELDING BY THE MILE

. . . produced by Pierce-Governed units!

●This case in point is a ten-inch oil line, 157 miles long from Mitchell, Illinois, to Terre Haute, Indiana—all electrically arc-welded. The unit is a Pierce-governed Lincoln arc-welder.

For strong, dense, leak-proof welds, *positive* power-unit regulation is essential. Pierce Flyball Governors give that kind of dependable control—the unfailing, instantly responsive, *mechanical* way. They hold the arc constant—give complete recovery of current characteristics in three-tenths of a second. They frequently give trouble-free performance even beyond the service-life of the engine itself.

* * *

That's why Pierce Governors are original equipment on many leading engine driven welders. Specify them on the new equipment you buy. Write for the new Pierce catalog if your present units are not Pierce-equipped.

THE PIERCE GOVERNOR COMPANY, INC.
1607 OHIO AVENUE • ANDERSON, INDIANA
Manufacturers of Pierce
Precision Governors and Sisson Automatic Chokes
Canadian Manufacturer and Distributor:
BURLEC LIMITED, Toronto 13, Canada

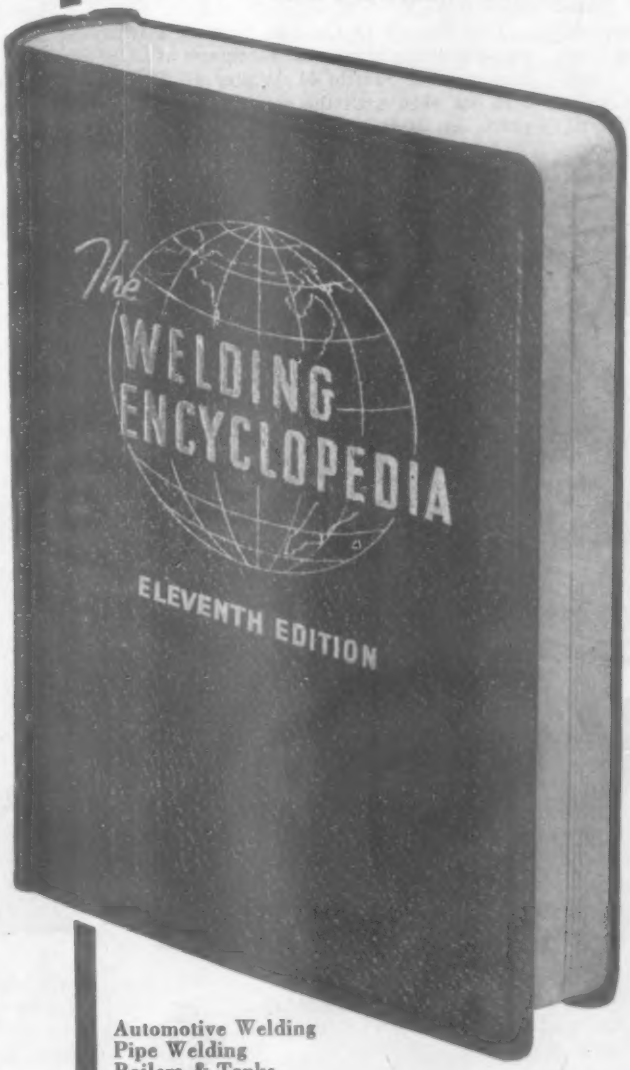
PIERCE GOVERNORS

NOW—NEW

THE 11th EDITION of the WELDING ENCYCLOPEDIA

• *Completely Re-Written —Up-to-the-Minute*

The 11th Edition of The Welding Encyclopedia comes to you completely re-written—reflecting the tremendous changes in welding wrought by the production necessities of American Industry at war. In its 22 years of service to the Welding Industry no single edition of The Welding Encyclopedia has presented so much completely new and vital information on welding practice. Edited and rewritten by T. B. Jefferson, leading technical editor and engineer, this complete reference book is a *must* on the list of every engineer and weldor.



One of the greatest values ever presented by a major reference book—980 pages of current authoritative information with 1359 illustrations on the world's most important and fast developing industrial process — Welding.

$6

• *25% Larger— 980 Pages— 1359 Illustrations*

The 11th Edition is a 25% larger volume—completely re-written. It is rearranged with easy-to-find cross-references and contains 1359 illustrations in its 980 pages. It brings to you, in its added size, a complete compilation of exhaustive research keyed to the demands of Industry's fastest growing fabricating process. It contains compact authoritative data—much of which can be found only in The Welding Encyclopedia, 11th Edition.

• *Every Major Field— 2000 Subjects*

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Heliarc Welding
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Gamma Rays
Magnetic Inspection
Flame-Hardening
Metallizing
Heat Treatment
Flame-Cutting
Metallurgy
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Covering more than 2000 subjects, completely indexed and cross-referenced—the 11th Edition of The Welding Encyclopedia gives up-to-the-minute complete coverage on every major phase of welding.

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My check ( ), money order ( ) is enclosed.

Ransome Co. Appoints 14 New Distributors

The Ransome Machinery Co., Dunellen, N. J., manufacturer of welding positioning equipment, announces the appointment of the following distributors:

Post Welding Supply Co., Birmingham, Ala.; Hobart Welder Sales & Service, Cleveland; W. P. & R. S. Mars Co., Duluth, Minn.; American Machinery & Supply Co., Omaha; Arcway Equipment Co., Pittsburgh, Philadelphia, Baltimore and Richmond; Hobart Sales Service Supplies, Buffalo and Syracuse; Peoria Welding Supply Co., Peoria, Ill.; Big Three Welding Equipment Co., San Antonio, Corpus Christi, Dallas, Houston and Fort Worth, Tex.; Moline Welding Service, Moline, Ill.; Chicago Welding Sales Co., Chicago; Victor Equipment Co., San Francisco, Fresno, Los Angeles and San Diego; Austin-Hastings Co., Inc., Cambridge and Worcester, Mass., and Hartford, Conn.; J. E. Raney and Co., Boston; Welding Engineering and Sales Co., New York City, Buffalo and Syracuse.

» «

New Square D Plant

The Square D Co. has opened a new manufacturing plant and warehouse at 2310 Ranier Ave., Seattle 44. Walter H. Bodle, who has been with the company for many years, has been appointed manager.

THE WINNAH

You'll be backing a winner when you put Marquette A.C. Arc Welders on your production line or in your maintenance department.

Old fashioned methods, requiring the extra cost and time needed for drilling, bolting, riveting or expensive, hard-to-get replacement parts haven't a chance against the speed, economy and streamlined efficiency of this modern method of metal fabrication or repair.

Buy The Best . . . Buy Marquette

LOW INITIAL COST—LOW COST OPERATION
NEGLIGIBLE UPKEEP—ALL ASBESTOS INSULATION
NO "MAGNETIC BLOW"—SUPERB ARC PERFORMANCE
10 Models, 125 to 400 Amps. Completely Equipped

Send for free, 24 page, illustrated booklet

MARQUETTE MFG. CO., INC.
Minneapolis 14, Minnesota

MARQUETTE
REGISTERED U.S. PAT. OFFICE

a.c. arc welders

H. C. Price Co. Awarded Five Pipeline Contracts

Three contracts for welding pipelines and two general contracts on pipeline construction have been awarded to the H. C. Price Co., pipeline contractors of Bartlesville, Okla. The welding contracts are:

For British American Oil Company, Ltd., 17½ miles of 6 in., 8 in. and 12 in. line near Calgary, Canada.

For Southern Detroit Gas Co., taking up and re-laying ten miles of 6 in. line south of Monroe, Mich.

For Ohio Oil Co., 115 miles of 8 in. line from Rockford, Ill., to Indianapolis.

The general contracts are:

For Shell Pipe Line Corp., laying 10 miles of new 6 in. line, taking up, reconditioning, etc. 16 miles of 6 in. line near Oxford, Kans.

For Sinclair Pipe Line Co., taking up, rough cleaning, hauling and racking 8 miles of 3 in. screw pipe.

» «

Frostrode in New Plant

Frostrode Products has moved to a larger plant at 19929 Exeter, Detroit 3. The new facilities, it is stated, will permit stepped-up delivery schedules on the company's lines of refrigerated welding units, resistance-welding electrodes, coolant coolers, etc.

» «

ASA Moves Address

The American Standards Association has moved to larger quarters at the Grand Central Terminal Office Building, 70 East 45th St., New York City 17.

ABOUT PEOPLE

Charles E. Wilson was re-elected president of the General Electric Co. at a recent meeting of the board of directors. **Owen D. Young** has resigned as chairman of the board.

» «

A. Carl Tiedemann has joined the Dockson Corp., Detroit, as executive vice-president and general manager. For the past two and a half years Mr. Tiedemann has been with the Office of the Chief Ordnance, Detroit, where he served as chief of the Parts and Supplies Branch, Engineering and Manufacturing Division. Previously, he had been with General Motors Corp. and with Nash-Kelvinator Corp. in official capacities.

» «

W. R. Persons, Pittsburgh district manager of The Lincoln Electric Co., has been transferred to the factory and main office at Cleveland. **J. S. Roscoe**, former district manager at Syracuse, has been appointed manager of the Pittsburgh office.

IT'S "KNOW-HOW" THAT PRODUCES RESULTS FOR NORTON RESINOID GRINDING WHEELS

1. **Research "Know-How"**—It took Norton laboratory men thousands of man-hours to perfect the various Resinoid bond formulas in use now—each right for a certain type of grinding.

2. **Manufacturing "Know-How"**—Men who have been making grinding wheels for from a quarter to a half century put their knowledge to use with the best equipment obtainable.

3. **Engineering "Know-How"**—But it's the Norton abrasive engineers who get into the shops and make the final selection—a selection that may make the difference between success and failure of a grinding wheel.

It's this combined "Know-How" that gives Norton wheels for weld grinding their outstanding performance.

NORTON COMPANY, WORCESTER 6, MASS.

Distributors in All Principal Cities

NORTON ABRASIVES

The executive staff of Universal Power Corp., Cleveland, has been augmented by **C. William Pfeil** as vice-president, **Frank Stockton** as chief engineer and **Fred Reinke** as welding engineer.

» «

Frank C. Angle, former manager of Allis-Chalmers sales activities in the Pacific region, has been appointed manager of the field sales offices of this company's general machinery division. He will continue, however, to supervise operations of the Pacific region.

» «

C. Leslie Jamison has been appointed vice-president in charge of sales for the Strauss Co. division of the Portable Lamp and Equipment Co. The division manufactures a line of safety hats and caps, safety belts and other types of accident prevention equipment.

» «

Ches Herndon, formerly with Hanlon Waters, Inc., Tulsa, has joined Tube Turns, Inc., as manager of the company's Houston, Tex., branch. His offices will be in the Commerce building.

» «

O. C. Tabbert, formerly welding engineer in the Milwaukee sales district, Harnischfeger Corp., has been appointed assistant manager of the P&H welding equipment division. The management of this division will continue under Marvin **H. Rutishauser.**

» «

Wilbur C. Osha, until recently general welding superintendent at the Berwick, Pa., plant of the American Car and Foundry Co., has been appointed general supervisor of welding. He will make his headquarters at Berwick but have charge of the supervision of welding operations at all twelve plants of this company.

» «

Ray C. Bender, formerly welding supervisor and engineer of the Continental Foundry and Machine Co., East Chicago, has been appointed Chicago district sales manager of the Alloy Rods Co. His headquarters will be at 3548 Archer Ave., Chicago 9.

» «

Harvey W. Blankenship, formerly advertising manager for Graver Tank & Mfg. Co., Chicago, has joined S. C. Johnson & Son, Inc., Racine, Wisc., as industrial sales promotion manager.

» «

Two members of the staff of American Steel & Wire Co., Cleveland, have exchanged positions. **Harry F. Clarke,** formerly director of spring mill products, has been appointed superintendent of the spring mill and rail bond department at South Works, Worcester, Mass. **Robert D. Knight,** who held the latter position, assumes Mr. Clarke's former duties.

» «

J. M. Stapleton, former superintendent of blast furnaces for Geneva Steel Co., Geneva, Utah, has been promoted to assistant division superintendent of blast furnaces at the South Works of Carnegie-Illinois Steel Corp., where he succeeds the late **R. D. Beck.** Both companies are United States Steel Corp. subsidiaries. At Geneva Steel, Mr. Stapleton is succeeded by **J. S. McMahon,** who was formerly assistant blast furnace superintendent at the Warren, O., plant of Republic Steel Corp.

» «

Robert E. Lewis has resigned as treasurer of the American Steel & Wire Co., U. S. Steel Corp. subsidiary, in order to become president of the Cleveland Wire Spring Co., an independent company.

» «

National Carbon Co. announces personnel appointments for its newly established divisional offices in New York City, Pittsburgh and Chicago. **F. W. Berdan** will manage the New York division with **G. A. Blackburn** and **A. B. Oatman** as assistant division managers. The Pittsburgh division will be in charge of **J. A. Hammond** with **F. S. Haggerson** and **W. E. Herr** assistant managers. **H. A. Stewart** will head the Chicago division with **C. H. Christensen** and **W. L. Julian** as assistant division managers. All of these men have been with National Carbon Co. for some years.

Grind Fast... Grind Smooth
with SKILSAW
PORTABLE GRINDERS!

● Put SKILSAW PORTABLE GRINDERS to work on your toughest bead grinding jobs and you finish the work *faster* and *easier!* That's the experience of busy welding shops where they take SKILSAW PORTABLE GRINDERS *right to the job* to speed all grinding and polishing.

These rugged grinders are quality-built throughout with special ball bearing inserts to absorb vibration and spindle thrust. That's why they run smoother... run cooler... last longer with less time out for servicing.

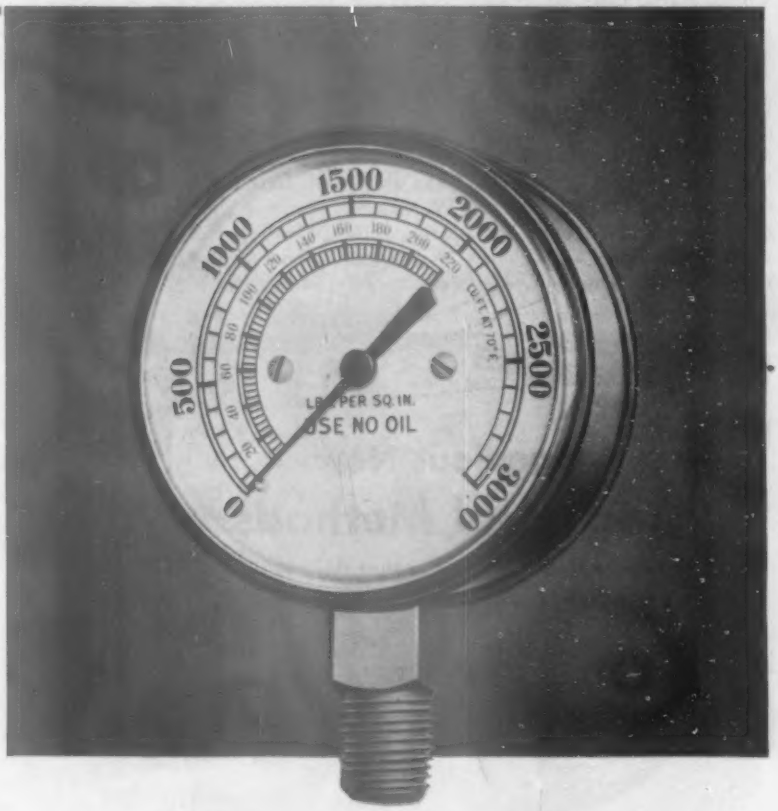
Ask your distributor today to demonstrate SKILSAW PORTABLE GRINDERS on your own work.

SKILSAW, INC.
5033-43 Elston Ave., Chicago 30, Ill.
Sales and Service Branches in All Principal Cities

SKILSAW PORTABLE ELECTRIC TOOLS
MAKE AMERICA'S HANDS MORE PRODUCTIVE

CORRECT PRESSURES FOR OXY-ACETYLENE OPERATIONS

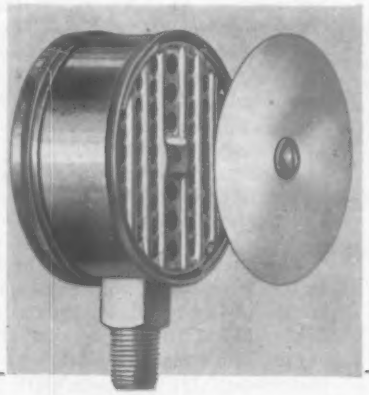
AUTO-LITE PRESSURE GAUGES



Operators who cut, treat or join metals by oxy-acetylene flame processes have the assurance and protection of proper pressures when their equipment includes Auto-Lite Pressure Gauges.

These gauges save man hours, serve to hasten essential production and conserve vital gases through precise pressure indication. Designed and manufactured by pioneers in the development of dial-type precision instruments, Auto-Lite Pressure Gauges are standard equipment for oxy-acetylene apparatus, and are listed as approved by Underwriters Laboratories.

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION
CHRYSLER BUILDING, NEW YORK 17, N. Y.



Rear view of pressure gauge shows grid-retainer plate — exclusive with AUTO-LITE gauges. This is a special safety feature which gives added protection to operator and plant equipment.

Gustuf A. Ostrom has joined Foote Mineral Co., Philadelphia, after six years of research and development work with Arcos Corp. on stainless steel and alloy welding electrode coatings, weld deposits, etc. He has also served four years with Philco Radio Corp. as a radio technician.

» «

Fred L. Curtis has been appointed manager of the sales engineering department of Norton Company, Worcester, Mass. He has been with this concern for 16 years, serving most recently as abrasive engineer in Detroit. **Fred W. Grant,** formerly abrasive engineer in the Milwaukee territory, has been appointed merchandising engineer. He is succeeded in Milwaukee by **Paul H. Carlson. E. C. Willey** succeeds Mr. Carlson as abrasive engineer for the Moline, Ill., area.

» «

N. J. Carbis has been appointed special railroad representative of the Champion Rivet Co., Cleveland. Mr. Carbis has had 30 years' experience in the railroad field, part of which time was spent as general boiler foreman for the Baltimore & Ohio.

» «

Leo Edelson resigned recently as executive vice-president of the Induction Heating Corp. in order to become president of the Metroloy Corp., New Rochelle, N. Y.

Now—Air Operated Collet Chuck Relieves Second Operation Work on Screw Machines

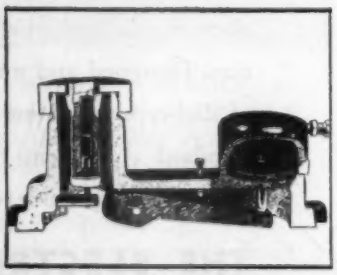
Work formerly requiring automatic or hand screw machines can now be done at much less cost through the combination of this new air chuck and any drill press. The Redmer Air Chuck is a collet air chuck using standard Brown & Sharpe type screw machine collets. The collet remains stationary, the opening and closing controlled by a sleeve action.

By using a collet as the chucking means, slight variations in the diameter of the work as frequently experienced with automatic and hand screw machine products can be permitted without sacrificing accuracy or concentricity. Thus accomplishing an important saving in time and cost.

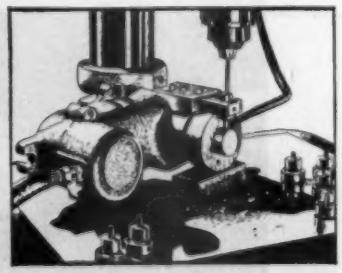
The air chuck is an ideal tool for holding parts for drilling, milling, slotting, burring, chamfering, boring, counterboring, tapping, threading, reaming and other work where the machine operation should be concentric with the chucking surface. It is adaptable to many different jobs merely by changing collet and stop. This results in saving of valuable production metals and materials. The chuck will take any type work whether round, hex, square or rectangular, and permits full efficiency of the operator, as it is operated by a foot operated valve thus leaving hands free to load and unload—reducing fatigue and cutting unproductive time to a minimum.

Wrigley's Spearmint Gum, too, **is a help on the job. For chewing gum helps relieve dry throat, and helps ease fatigue brought on by the strain of work. And at the same time you are chewing and getting the benefits of swell tasting Wrigley's Spearmint, both hands are free and you need not take a "time out." The Army and Navy have recognized these benefits and are now shipping overseas *only,* all of the limited production of Wrigley's Spearmint. When Wrigley's Spearmint can again be produced in sufficient quantity for all, the valuable benefits of Wrigley's Spearmint Gum now being proven on the battlefield will apply to industry here at home.**

You can get complete information from Redmer Air Devices Corp., 601 West Washington Blvd., Chicago 6, Ill.



An air operated collet holding fixture for precision chucking or machine tools



Chuck can be mounted on angle for angle milling job

Y-151

M. E. Capouch has been appointed assistant manager of construction materials sales of the American Steel and Wire Co., Chicago. He succeeds **O. T. Allen,** who has retired after an association of 35 years with the company.

» «

Roscoe H. Smith, formerly manager of applied engineering, has been named manager of the newly established sales promotion department of The Reliance Electric & Engineering Co., Cleveland. He will be assisted by **Kenneth F. Ertell,** who has been named assistant advertising manager. **Richard A. Geuder,** former manager of metal industry applications, will assume Mr. Smith's previous responsibilities.

» «

F. M. Beaudoin, formerly employment manager of United States Steel Supply Co., Chicago, is now manager of industrial relations of the Petroleum Iron Works Division of the United States Steel Products Co., Sharon, Pa.

» «

R. T. Muench, formerly manager of the Detroit X-ray office, Westinghouse Electric & Mfg. Co., has been made manager of the company's X-ray products department. He will make his headquarters at Wilkinsburg, Pa.

» «

Howard R. Murphy has resigned as manager of the merchandise department of the Caterpillar Tractor Co., Peoria, Ill., in order to become associated with **W. K. Holt** in the Caterpillar distributorship in San Antonio and Corpus Christi, Tex.

» «

Died . . .

Berthold Francis Hastings, district engineer of the American Institute of Steel Construction, died September 11 at Philadelphia, where he had represented the Institute since 1928. Previously he had been a designing and construction engineer for H. G. Balcom, New York City, and had also served as professor of structural engineering at the Carnegie Institute of Technology.

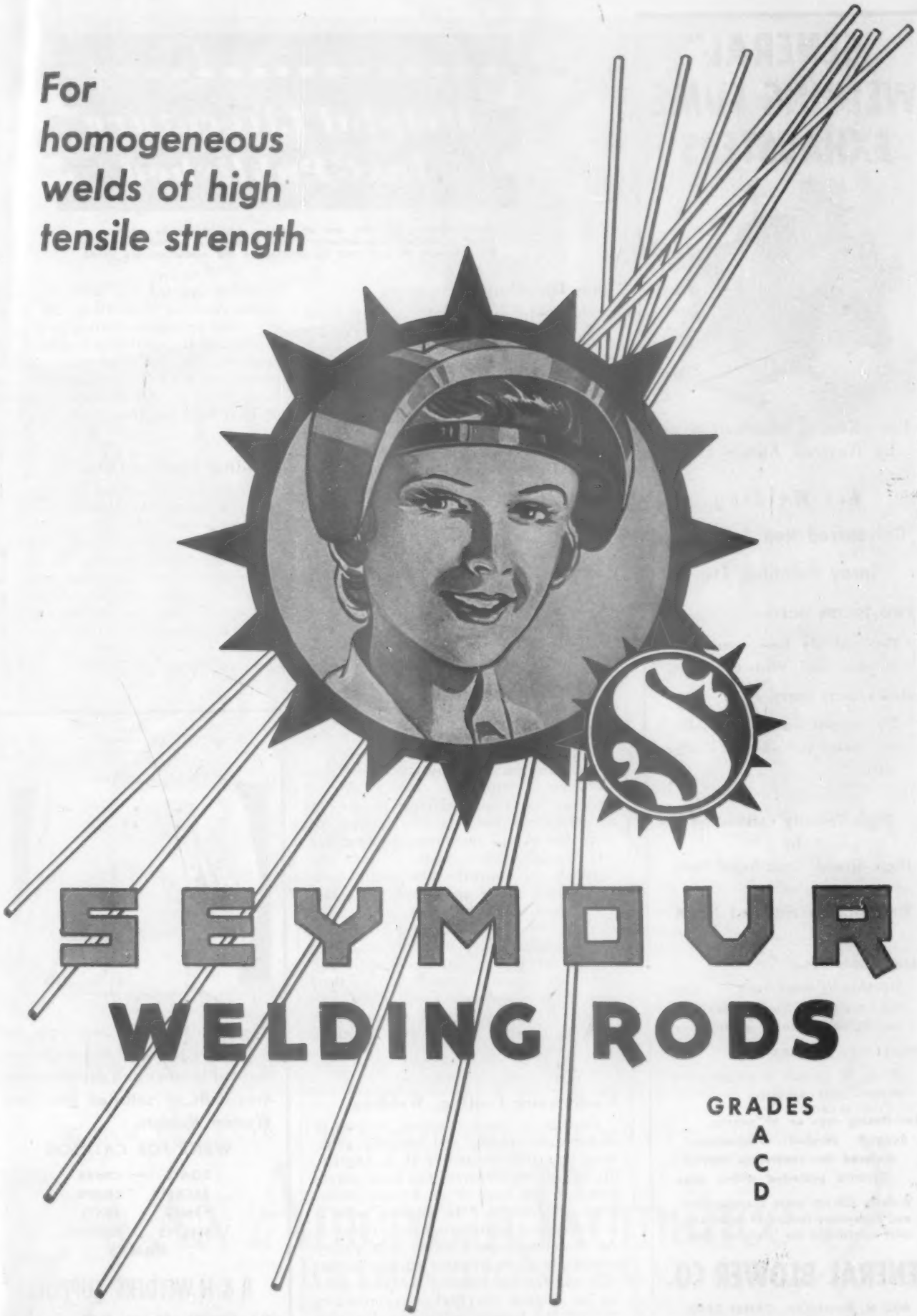
» «

Raleigh H. Barnes, 46, assistant director of research of the American Steel & Wire Co., died Saturday afternoon, September 2, after collapsing after a golf game. The cause of death was coronary thrombosis. He had been with American Steel & Wire since 1920, serving as laboratory assistant, assistant district metallurgist, division metallurgist and finally as assistant director of research.

» «

Philip G. Johnson, 50, president of the Boeing Aircraft Co., Seattle, died September 14 at Wichita, Kas., following a stroke he had suffered the day before while visiting local Boeing officials. Mr. Johnson had been in charge of the Flying Fortress and Super Fortress construction programs.

For homogeneous welds of high tensile strength



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High Velocity Exhaustion by High Speed Centrifugal Fans for Small, Easily Handled Hoses

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PORTABLE "JUNIORS"—

40 to 100 pounds in weight; one or two inlet nozzles.

Self-closing caps on all nozzles.
Rugged, all-steel construction.
Motored for continuous service.
Controls protected within base.

Bulletin GB-103 gives specifications and dimensions for the 88 types and sizes comprising the "General" line.

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Pittsburgh Philadelphia Cleveland

Helpful Literature Just Published

The following reviews are of recent publications of interest to those in the welding industry. Unless otherwise stated, they may be obtained without cost by writing to the manufacturers listed.

Gas Distributing Systems

All that it is necessary to know about the design and installation of pipeline distributing systems for oxygen and fuel gases is told in a comprehensive 88-page, letterhead-size manual, "Oxy-Acetylene Pipeline Distributing Systems," published by Victor. Among the many subjects discussed are such topics as: acetylene gas generators, what may cause acetylene generator explosions, generator building and installations, storage of calcium carbide, cylinder manifolds, blueprint marking, design of pipeline distributing station outlets, station outlet regulators, construction of the acetylene distributing line, construction of the oxygen distributing line.

Distribution of this book is limited to the available copies. **Victor Equipment Co.**, 844-54 Folsom St., San Francisco 7.

» «

Welding Symbols Chart

A new 16¾ by 21¾ in., three-color wall chart permits handy reference to the basic welding symbols recommended as American Standard by the American Welding Society. This chart gives: (1) symbols for fusion welding, (2) symbols for resistance welding, (3) symbols for both fusion and resistance welding and (4) typical welded joints, sections and symbols. Section (4) reproduces 23 typical welded joints and covers butt, lap, tee, corner and edge welds.

With the aid of these symbols, complete welding information can be placed on the drawings in convenient shorthand form. It is recommended that at least one of these charts be hung on the wall of the drafting room and others in the welding booths. **The Hobart Brothers Co.**, Troy 1, O.

» «

Underwater Cutting, Welding

Because of the widespread interest in underwater cutting and welding practices, an article written by H. L. Ingram, Jr. for *Marine Progress* has been republished in the form of an 8-page, letterhead-size bulletin. Mr. Ingram, who is in the applied engineering department of Air Reduction, opens with a brief history of the use of underwater cutting in marine salvage operations. He then goes on to discuss the high gas pressures needed, the human limitations, the correct gas mixture, carbon-arc cutting and underwater welding. A table gives the compressed air, hydrogen and oxygen pressures needed for torch cutting at depths varying from 10 to 225 ft, also the water pressures existing at the listed depths and the particular lengths of hose required. Another table gives suggested cutting tip sizes for material thicknesses from ¼ to 2 in. **Air Reduction Sales Co.**, 60 East 42nd St., New York City 17.

» «

Welding Fittings Data

A 20-page booklet has been prepared by **Tube Turns, Inc.**, Louisville, Ky., to give allowable working pressures for welding fittings in five classes of piping: power, oil, district heating, gas and air, and refrigeration. Fourteen tables list allowable pressures at the indicated temperatures for any size and weight fitting of this manufacture. All tabulations are made in accordance with the Code for Pressure Piping, ASA B31.1—1942.

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Drawing by Peter Helck

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Hardfacing Worn Valves

Engine exhaust valve replacement is a pressing wartime problem in the maintenance of motor vehicles. Valve wear has been accelerated by heavy service, yet new valves for replacement are practically unobtainable. Particularly timely, therefore, is a 16-page, letterhead-size bulletin entitled "Rebuilding Worn Valves by Hardfacing."

This publication groups worn valves into three groups: those not badly burned or guttered; those which have the faces too badly guttered, pounded or burned to permit reclamation by grinding; those which have deeply burned areas, gutters and cracks. Naturally, most of the text deals with the reclamation of valves in the latter two classes. Valves which would ordinarily be replaced can be successfully salvaged, it is stated, by filling up the cracks and building up the worn faces with special hard-facing material applied by means of the oxy-acetylene torch. Instructions are given for cleaning and inspection of the valves, preparation for hard-facing, application of the hard-facing metal and finishing, while numerous illustrations picture the best methods of performing these operations. **Air Reduction Sales Co.**, 60 East 42nd St., New York City 17.

» «

Steel Products Manual

Sixth revision of "Steel Tubular Products," Section 18 of the Steel Products Manual, has been issued by the **American Iron and Steel Institute**, 350 Fifth Ave., New York City. This 164-page, 6 by 9 in. book is divided into five sections: (1) definitions, classifications and manufacturing practices; (2) stainless tubular products; (3) tables of dimensions, weights, hydrostatic test pressures, threading data, etc.: (4) standard machining allowances for seamless tubing for aircraft shock struts and landing gear; (5) standard methods of packaging and loading steel tubular products. The last previous revision of the tubular products section was in September, 1942.

» «

Tool Salvage Leaflet

How a broken $100 gear cutter was salvaged by brazing it with silver brazing alloy is detailed in "Low Temperature Brazing News No. 28," a two-page, letterhead-size bulletin published by **Handy & Harman**, 82 Fulton St., New York City 7. Pictures supplement the text in order to make clear each of the basic five steps in this type of repair; namely, cleaning and fluxing, pretinning, assembling, brazing and cooling.

» «

Shot Peening Booklet

The result of many months' laboratory research, a study titled "Shot Peening and the Fatigue of Metals" has been published by **American Foundry Equipment Co.**, 555 S. Byrkit St., Mishawaka, Ind. This is the work of H. F. Moore, for many years research professor of engineering materials at the University of Illinois. The booklet is illustrated by microphotographs, charts and tables, and it contains research data never before published. Among the subjects covered are: types of structural damage of metals, how shot peening increases resistance to plastic distortion, the origin of fatigue cracks, the effects of cold working, measurement of shot-peening intensity, examples of increased fatigue life from shot peening, etc.

» «

Rotary Shears Bulletin

Bulletin No. QW-120 features the applications and operation of attachments used on "Quickwork" rotary shears. This eight-page bulletin covers circle cutting, slitting, joggling and flanging attachments. **Quickwork Division of Whiting Corp.**, Harvey, Ill.

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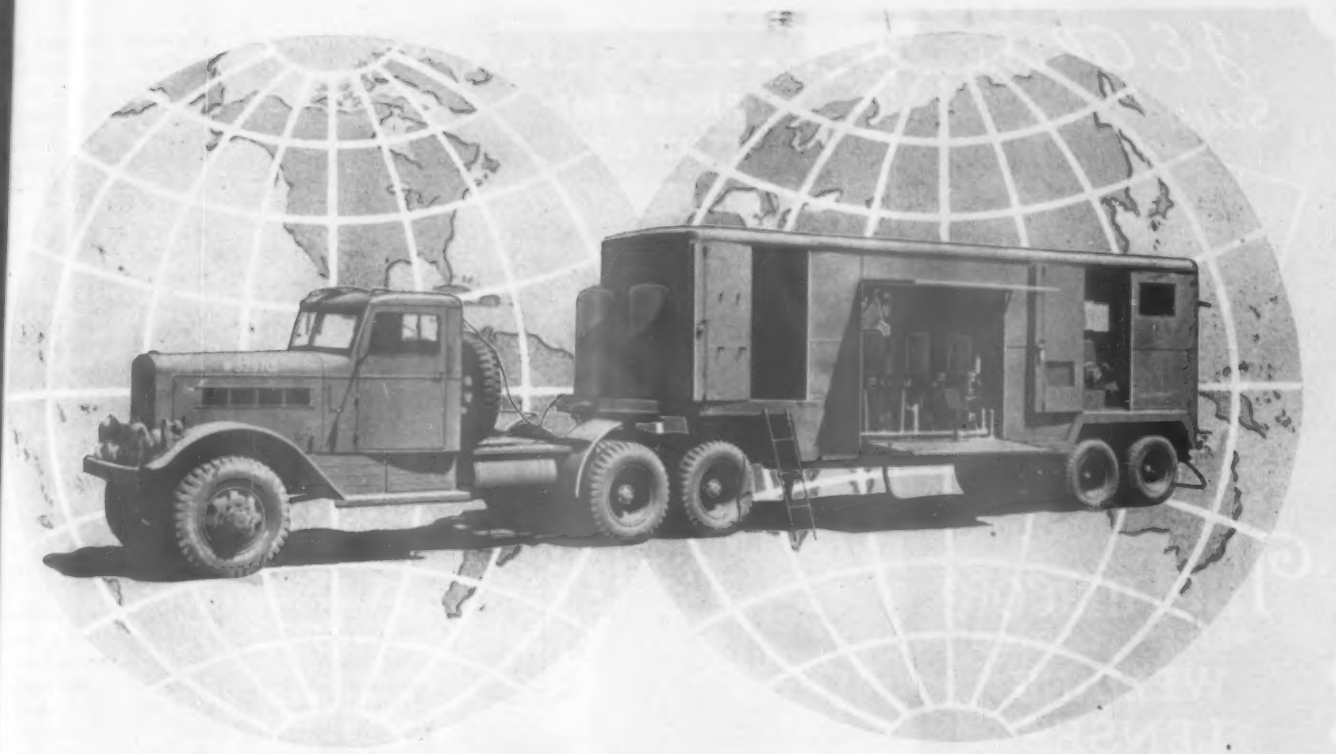

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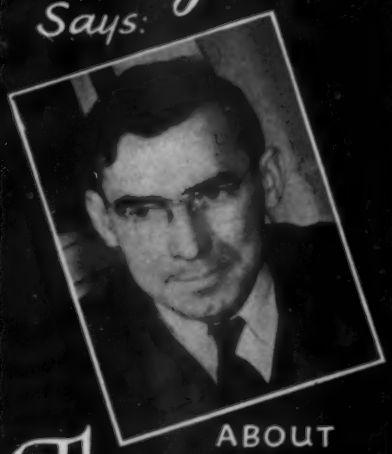

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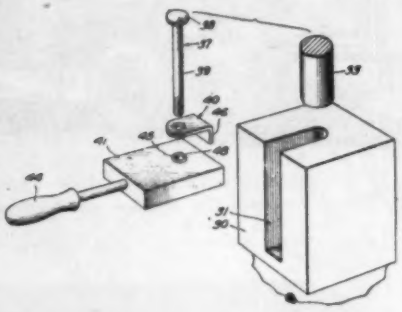
FROM THE PATENT OFFICE

Projection-Welding Jig

2,355,444. **William J. Kenny,** Berwyn, Ill., assigned to **Western Electric Co.,** New York City. Filed Nov. 7, 1942. Issued Aug. 8, 1944.

A combined work-holder and electrode



extension device for a spot welder, consisting of an apertured block of conducting material adapted to support parts to be welded. The block is insertable between the two electrodes, one of which has a slot for laterally receiving a portion of one of the parts. That portion of the part also enters into and extends from the aperture of the block. A handle is secured to the block.

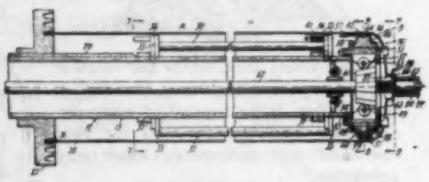
» «

Flash-Welding Method

2,354,173. **George H. Phelps,** Floral Park, N. Y. Filed Aug. 8, 1941. Issued July 18, 1944.

A method for flash welding two pieces of metal having edge portions of different thickness and of different distances from a surface. The pieces are pressed together in edge-to-edge contact, and an electric current is caused to flow through the contacting edges. The latter are shaped to effect a progressive separation of the edges inversely as the thickness of the edge portions and the distance from the surface with which electrical contact is made.

» «



Welding Jig

2,353,868. **David P. Bisbee,** San Marino, Calif., **Richard J. Seltzer,** Chicago, and **Philip F. Thayer,** Sparrows Point, Md., assigned to **Rheem Mfg. Co.,** Richmond, Calif. Filed Jan. 2, 1942. Issued July 18, 1944.

A welding jig for a circumferential weld on a cylindrical tank. A mandrel is supported at one end to rotate about a horizontal axis. A chuck mounted on the mandrel intermediate its ends receives and supports one end of the cylinder. An expanding weld back-up means at the free end of the mandrel is arranged to engage the inner side of the edge portions of the other end of the cylinder and also the end of the member to be connected with it, holding these portions in axial alignment. Axial movement is limited by a stop which engages a portion of the back-up. The stop is formed to engage the end face of the engaged member while the latter is supported on the portion of the back-up which engages it.

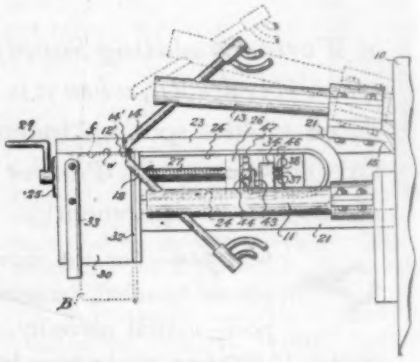
» «

Flash-Removing Mechanism

2,354,289. **Claude R. Babb,** Lakewood, O., assigned to **The Yoder Co.,** Cleveland. Filed June 6, 1940. Issued July 25, 1944.

A machine for shearing off the welding flash formed on the inner wall of a tubular member. The latter is moved endwise while a cutting device slides alongside its inner walls. The cutting device is an elongated body with spaced side portions forming between them channels open at the outer end of the elongated body. A portion of one of the side portions terminates in a cutting edge disposed in inclined relation to the flash. Flash is sheared off along a transversely inclined line because of the longitudinal movement of the tubular member relative to the cutting device.

» «



Spot-Welder Work Feeder

2,355,576. **Harry A. Werfel,** Essex Fells, N. J. Filed May 25, 1943. Issued Aug. 8, 1944.

In a spot-welding machine, an electrically insulated movable work-holding means for moving the work while it is operatively engaged by the electrodes. A rotatable feed screw continuously advances the work-holding means and the work it carries. An electrical circuit make-and-break switch controls delivery of energizing current to the electrodes while they are operatively engaged with the moving work. Switch has an oscillatable actuating lever which engages a cam that is actuated by the rotation of the feed screw. Selected pitch of the feed screw and/or selected shape of the cam determine the relative spacing of the succession of spot welds.

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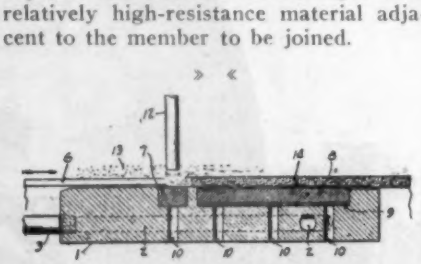
Resistance Brazing

2,356,049. **Arthur E. Goodwin,** Pittsburgh, assigned to **Westinghouse Electric & Mfg. Co.,** East Pittsburgh. Filed June 19, 1942. Issued Aug. 15, 1944.

A method of resistance brazing together a pair of metallic members of relatively high and of relatively low conductivity. A separate bimetal pad is interposed between one of the members and the copper-alloy electrode associated with it at the zone where the weld is to be made. A welding current is then passed through the electrode, the pad and the two members. The bimetal pad has a layer of a relatively low-resistance metal adjacent the electrode and a layer of a relatively high-resistance material adjacent to the member to be joined.

» «

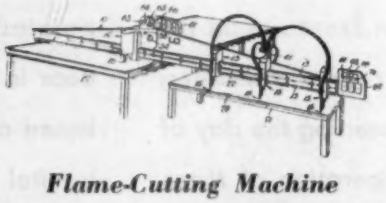


Arc-Welding Chill

2,357,170. **Albert W. Burggraf,** Milwaukee, assigned to **A. O. Smith Corp.,** Milwaukee. Filed Aug. 3, 1940. Issued Aug. 29, 1944.

A water-cooled block of heat-conducting material having a removable plug that is set directly beneath the arc in good thermal contact with the block. The plug can be readily removed and replaced when worn by the heat of the arc. Also set into the block is a metal insert, upper surface of which is below the corresponding upper surface of the block; this insert extends in the direction of the seam.

» «



Flame-Cutting Machine

2,356,215. **Alfred F. Chouinard,** Chicago, and **Louis A. Bordeaux,** Lincolnwood, Ill., assigned to **National Cylinder Gas Co.,** Chicago. Filed April 19, 1941. Issued Aug. 22, 1944.

A flame-cutting machine having a torch supported for movement on a carriage, a conduit for delivering gas to the torch, and a valve in the conduit remotely controlled by a pair of spring-pressed electric switches. A means responsive to manipulation of one of the switches from a normal position and against the action of its spring opens the valve. The switch returns to normal position under the action of its spring after being released, but the valve is maintained open until it is closed by the second switch.

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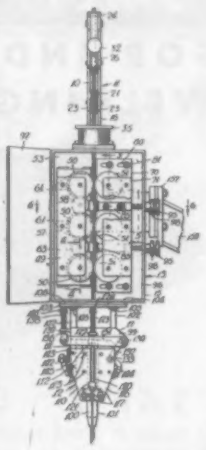

2,355,983. **Russell E. Long,** Western Springs, Ill., assigned to **National Cylinder Gas Co.,** Chicago. Filed Jan. 23, 1943. Issued Aug. 15, 1944.

An automatic arc-welding apparatus having a pair of contact members which are on opposite sides of the path of electrode travel. The contact members hold the electrode rod, guide it and supply current to it. A resilient means acts against one end of one of the contact members to press it toward the other contact member. A separate resilient means acts adjacent to the opposite end of the first member to resiliently press it toward the second contact member.

» «

Thermit Welding Material

2,355,627. **Charles A. Cadwell,** Cleveland, assigned to **The Electric Railway Improvement Co.,** Cleveland. Filed Jan. 21, 1941. Issued Aug. 15, 1944.

A thermit welding material for use in an exothermic reaction. It consists of a mixture of aluminum and copper oxide, the latter containing an amount of combined oxygen sufficient to yield enough heat to elevate the molten product to a temperature between 2,700 and 3,500 F when the oxide is reduced by the aluminum during the exothermic reaction.

» «

Welded Storage Tank

2,355,947. **Otto Bondy,** Worcester Park, and **Alexander George Grant,** Darlington, England. Filed Dec. 18, 1942 (in Great Britain Oct. 13, 1941). Issued Aug. 15, 1944.

This storage tank has a cylindrical metal shell, a plurality of circumferential bands, a plurality of axial beams and a plurality of radial bracing brackets. The spaced circumferential bands are welded to the outside of the shell for stiffening purposes, and the axial beams are disposed about the outer periphery of the shell, out of contact with both shell and the circumferential bands. The inner edges of the bracing brackets are welded to the tank shell and to the circumferential bands, while the outer edges of the brackets are welded to the axial beams.

» «

Torch Tip

2,356,196. **Malcolm H. Barnes, Charles J. Burch** and **William G. Edwards,** Kenmore, N. Y., assigned to **The Linde Air Products Co.** Filed March 30, 1940. Issued Aug. 22, 1944.

A torch tip having outlet passages converging at an acute included angle. The passages are adapted to discharge at least two gas streams at substantially equal velocities, one passage discharging a stream of fuel gas and the other an oxidizing gas. The axes of the passages lie in the same plane, and their discharge orifices coincide in the plane of a surface of the tip to form a common discharge orifice. The fuel-gas stream and the oxidizing stream will collide in the common discharge orifice to produce a single combustible gas stream immediately externally of the tip.

» «

Multiple Spot Welder

2,354,313. **Marcus R. Harris,** Indianapolis, assigned to **General Motors Corp.,** Detroit. Filed July 24, 1939. Issued July 25, 1944.

A multiple spot welder for making a series of welds in sequence. Elements are a fluid-pressure system including means for causing a rise and fall of pressure, an indexing switch operated by pressure changes, a pluraliy of electrically actuated valves controlled by the indexing switch and a series of welding electrodes operated by pistons. Each of the valves has a passage forming a portion of the fluid-pressure system, permitting fluid to be conducted from the valves to the electrode-operating pistons. The electric circuit actuating each valve is completed in a different position of the indexing switch.

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COLONIAL TANNING CO.

Glove and Garment Leather Division

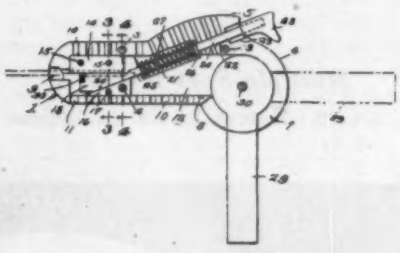
MILWAUKEE, WIS.

Coated Electrode

2,357,250. **Walter L. Baker,** Covington, Va., assigned to **West Virginia Pulp and Paper Co.,** New York City. Filed March 24, 1943. Issued Aug. 29, 1944.

A ferrous electrode having an inner coating of fluxing substance and outer covering of paper. The inner layer consists of a hard, glassy coating of borax pentahydrate.

» «



Electrode Holder

2,357,529. **Everett Dougald McKellar,** Kirkland, Wash. Filed June 21, 1943. Issued Sept. 5, 1944.

A welding electrode holder with a casing having an elongated chamber and provided at its forward end with a rod-receiving opening. The casting has a recess communicating with the chamber and defining forward and rear shoulders; the longitudinal axis of the recess is disposed at an acute angle to the longitudinal axis of the chamber. A pair of conducting members are fixed in the casing at the sides of the chamber, and a fixed jaw is disposed between the conducting members and located near the opening. A conducting arm engages the conductive members near the rear end of the casing, and a pivot element engages the arm and the rear portions of the conducting members. A straight handle is mounted for longitudinal reciprocation in the casing and extended through the recess. On the rear end of the handle is a means for receiving thrust-actuation directly from the hand of an operator when the hand receives the arm. A compression spring in the recess engages the forward shoulder and an abutment on the handle. The rear shoulder forms a stop, which the abutment engages. In the casing is a track having a longitudinally inclined surface; a movable jaw secured to the handle has an inclined surface coöperating with the inclined surface of the track to move the jaw transversely away from a fixed jaw when the handle is advanced against the effort of the spring.

» «

Electrode Holder

2,358,220. **Thomas S. Donnelly, Jr.,** Detroit, assigned to **Bordon Mfg. Co., Inc.,** Detroit. Filed Feb. 19, 1943. Issued Sept. 12, 1944.

An electrode holder having a pair of supporting members on each of which a gripping jaw and an insulation plate are detachably mounted. The insulation plate and the jaw engage each other in binding relation to each other and to the supporting member.

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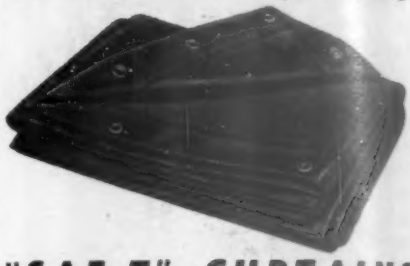

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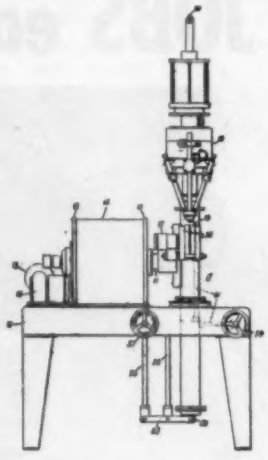
2,358,144. **James T. Catlett,** Scotia, N. Y., assigned to **General Electric Co.** Filed Nov. 4, 1940. Issued Sept. 12, 1944.

Welding apparatus comprising a welding agency of substantially constant heat output and a work clamp having heat-conducting jaw members to engage the work on opposite sides of the seam to be welded. The welding agency and the work clamp are moved relatively to one another along the seam at a substantially uniform rate of speed, with the welding agency spaced at substantially uniform distance from the seam. The relative spacing and heat conductivities of the jaw members are such as to increase the conduction of heat from the seam at its ends and thereby reduce weld penetration and prevent notching of the work at the ends.



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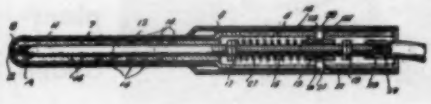
Spot-Welding System

2,353,733. **Hans Klemperer,** Belmont, Mass., assigned to **Raytheon Mfg. Co.,** Newton, Mass. Filed July 3, 1943. Issued July 18, 1944.

A resistance-welding system comprising a circuit for supplying energy from a power source through the primary winding of a transformer to induce welding impulses through the secondary winding. There are also: (1) means for resetting the flux in the transformer and (2) a means responsive to a failure of the flux resetting means for disconnecting the power source from the circuit.



Electrode Holder

2,357,663. **George Ray Klingenberg,** San Francisco. Filed May 4, 1943. Issued Sept. 5, 1944.

An electrode holder having an elongated hollow member and a plunger. Electrode is received into an opening at one end of the hollow member. A spring is compressed to hold the plunger in engagement with the electrode; the means for compressing the spring comprises a movable handle and a collar having a pin projecting through a bayonet slot.

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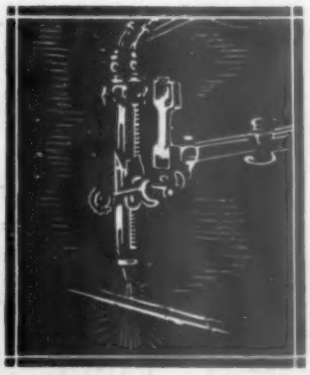

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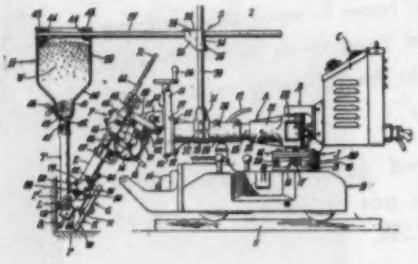
Submerged-Melt Apparatus

2,357,376. **Albert W. Baird,** Cranford, N. J., assigned to **The Linde Air Products Co.** Filed Sept. 17, 1943. Issued Sept. 5, 1944.

Fillet-welding apparatus designed to be moved along the intersection of angularly disposed metal members, one of which is horizontal. A supporting arm at one end of the device is mounted for movement in a horizontal plane and for oscillation through a limited distance in a vertical plane; an electrode-feed mechanism is adjustably mounted on the other end of the supporting arm. A means operatively associated with the feeding mechanism conducts electric current to the welding wire. Feed and electrode are guided along the intersection of the members being welded by a device which includes a first guide adjustably mounted and adapted to urge the welding wire forward and a second guide adapted to restrain the movement of the wire.



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Submerged-Melt Backing Strip

2,357,402. **Franklin C. Hasse** and **Arthur A. Bernard,** Chicago, assigned to **The Linde Air Products Co.** Filed March 1, 1940. Issued Sept. 5, 1944.

An imperforate unitary gasket of yieldable material constructed to engage the under surface of a lower member being welded and to coöperate with it to form a single fluid-tight channel directly beneath and bridging the line of application of welding heat. A portion of this gasket provides the entire bottom wall of the channel, which is arranged for circulating through a heat-absorbing medium under pressure along a portion of the under surface. A support for the gasket is designed to hold it fluid-tightly against the under surface, and clamps are constructed to engage the upper surface of the upper metal member being welded and hold it in welding position relative to the gasket and support. Room is left between the clamps for the application of welding heat to the upper member.

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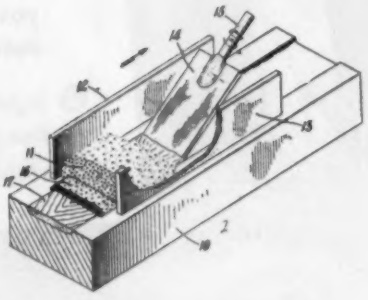

Submerged-Melt Welding

2,357,432. **Harry Shrubsall,** Lewiston, N. Y., assigned to **The Linde Air Products Co.** Filed Jan. 12, 1943. Issued Sept. 5, 1944.

A method of welding in which a comminuted mineral-like welding composition is laid on the workpiece. This composition is a non-conductor of electricity in the solid state but a high-resistance conductor when molten. The end of a bare metal electrode in the form of a strip or ribbon, at least 1 in. wide and greater in width than thickness, is inserted into the composition, a portion of which is fused in contact with the electrode end. The electric current passes through the electrode, fused portion and workpiece, causing metal to be melted from the electrode and deposited on and coalesced with the molten metal of the workpiece. The electrode is rocked to bring its opposite side edges alternately toward and away from the workpiece in order that the point of electrical discharge will reciprocate from edge to edge of the electrode.

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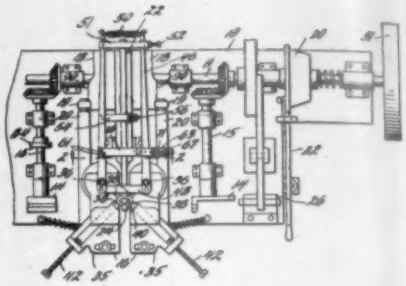

Butt Welder

2,354,983. **Gustave K. Blum** and **Arthur E. Peters,** York, Pa., assigned **The McKay Co.,** Pittsburgh. Filed Feb. 11, 1938. Issued Aug. 1, 1944.

A method of butt welding two bar ends of a given cross-section. The ends are held together in abutting relation with a force that can be varied at different stages in the welding cycle. Current is passed through the abutting ends. The normal yielding of the ends as they fuse is, however, at first resisted by counter pressure. The resistance to the follow-up pressure is then reduced in proportion to the travel of heat backward from the joint.

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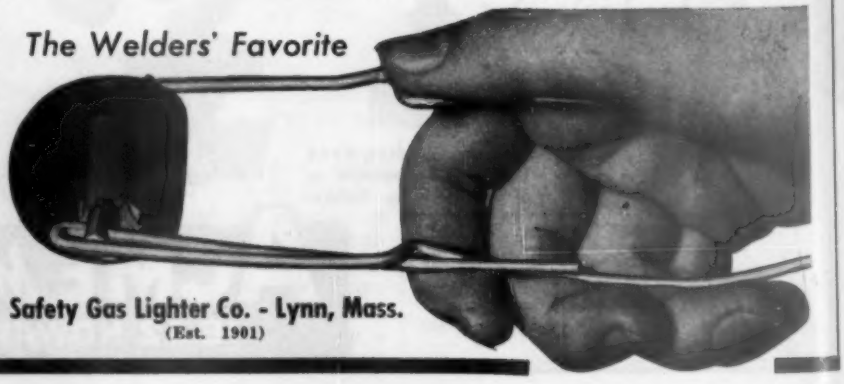

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